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Domestic Appliances.

[Prepared for the Tenth Meeting, Iowa District Gas Association, by MR. C. W. LOCKWOOD.]

The number and variety of gas appliances manufactured for use in the home is increasing yearly, and we find, generally speaking, that the quality, with reference to material used and the finished appearance, bears comparison with any other line of articles made for domestic use. We wish to call to your attention some of the more desirable features of the various appliances from the standpoint of the man who has to meet the user, or prospective purchaser, of a gas consuming device; and who, therefore, hears the many and varied comments on details of construction, operation and design, which are passed when endeavoring to make a sale. We will first consider the gas range as holding the premier position in domestic appliances.

The gas range has been subject to many changes in design and in the construction of its various parts. We have the single and double types, with the ovens below the cooking surface; the elevated type, with the ovens above the cooking top; the standard cabinet, in which economy of length is not considered; the short cabinet, with ovens and top burners designed to occupy as little space as possible; and the large cabinets, with the number of top burners and ovens limited only by the requirements of the consumer. Some features of construction are applicable to all of these designs. The casting should be of a neat plain pattern with a smooth surface, free from all unnecessary ornamentation, and finished with a coat of dead black, baked hard enough to remain clear and unsullied when handled; all holes in base casting and legs to be reamed out slightly larger than the bolt used; top grate castings to be fitted to lay perfectly level, with all sharp edges and rough projections removed and to be so designed as not to interfere with the gas flame. The top burners should be designed to give the maximum amount of heat obtainable from the gas consumed. A raised tip, or flame stool, assists in providing means for the secondary air to reach each flame tip and the design of burner should be such as not to interfere in any way with a plentiful supply of air reaching these tips. The burner hangers should hold the burner perfectly level, in order to bring each flame tip the same distance from the top of the grate; and supports and hangers should be removable without having to loosen any bolts or screws. Oven burners should have sufficient weight and be of material that will retain its shape while in use, and should also be made to fit right side up only and be easily removable for cleaning. The body of the range to be made of a high grade steel with smooth, hard finish, free from scale, and to be treated with a light coating of grease before leaving the factory. The oven linings and rack supports to be heavy enough to retain their shape when handled and have corners of rack supports rounded. A process for making oven linings rust proof is very desirable, and would be most serviceable if given a dark finish, which would not show the marks of usage and age. The broiler pan and drip pan should be enameled, and made with inside corners rounded to facilitate cleaning. Enameled burner boxes are also desirable and give a finished appearance to the range. The valve manifold should be of ¾-inch pipe and if drilled and tapped, for valves should be of extra heavy pipe to allow sufficient threads to make a strong, tight connection. To insure perfect combustion great care is necessary to get all valves exactly in line. A spring on the stem of lever cocks is also a desirable feature. Adjustments for both gas and air must be so arranged as to be easily changed and remain in position when set. They should be made so that it is not necessary to entirely remove the screw when a change of air adjustments is necessary. In single and double oven ranges an arrangement whereby the oven burners can be lighted from the front of range is desirable and, if the flame of both burners is visible without opening the oven doors, it adds to the desirability of the appliance. The baking oven of cabinet ranges should not be less than 14 inches in height and the valve manifold should not extend along the end of the oven. A drop door on all cabinet ranges not exceeding 4 feet 6 inches in height seems to add to the selling points of the range. Another good feature is to have the splasher-back and end of oven enameled. Top burner lighters add materially to the utility of a gas range, but must be simple in construction and control the gas absolutely, and have a pilot light which cannot come in contact with the dome which protects it. The lighter must be centrally located so that the points of flame will reach each burner and light it without having to place a utensil over the burner. A flash lighter gives the best results and is the best seller. Gas plates and laundry stoves should be equipped with burners having gas and air adjustments the same as on ranges and, where possible, should be connected with pipe instead of rubber tubing. Whenever it is necessary to use tubing, it is advisable to use a metal tubing. An improvement on the metal tubings now on

the market would be a connection made of metal eliminating the use of rubber ends.

Next to the gas range the heating of water by gas probably receives the most consideration by the consumer, and by the companies selling appliances. Gas water heaters are made in various designs, and each has some special point which the manufacturer considers makes his heater superior to all others. The instantaneous automatic is an ideal type of water heater for domestic use, and during the last two or three years has been perfected in sizes suitable for all classes of consumers. A heater of this type should have a copper coil of such form as to give maximum surface exposed to the heat from the gas flame, and the baffle plates placed to distribute the heat to the coils, so that there is as little waste of heat as possible; a thermostat, reliable and unfailing in its action; quick action of the gas valve when water is turned on or off; burners aad coils to be protected as much as possible from condensation; pilot to have protection from condensation and baffle plate or hood, so that flame does not come in contact with coil, which would tend to lime up the coil; coils should be easily removable for cleaning, and as the lower coil usually is the only one which needs attention, it should be constructed so as to be removable independent of the others; arrangements should be made to easily drain the coils of water and all coils should be given a thorough test before leaving the factory; flue connections so made as to prevent any possibility of down draught; adjustment of both gas and air to each burner so that they can be easily changed when necessary.

For the instantaneous bath room water heater, the flue connection should prevent down draught; interlocking of gas and water valves, so that the gas cannot be turned on without first opening the water valve, is absolutely necessary; an adjustable gas nozzle or spud, and air shutter which can be changed without disconnecting the heater, would be of great value.

In tank heaters the copper coil circulating heater seems to be the most desirable, and most efficient. Coils should be given a severe test before leaving the factory, and to eliminate all danger of explosion, heaters must be made so that burner cannot be lit until door is opened or jacket raised to ventilate. There are various other forms of tank heaters on the market, which are giving more or less satisfaction, determined mainly by their ability to assimilate heat from the gas consumed. We connot attempt to ennumerate the good points of all the types of gas heating stoves which have been developed. They are made in sizes, from the large heater for a whole house, to the small types, suitable for use on a gas fixture. The most essential feature in any type of gas heater, whether large or small, is the absence of odor from the burnt and unburnt gases, as we find that the most frequent cause of complaint from them is the unpleasant smell occasioned by incomplete combustion of the gas. It is bad practice to have a gas valve on the heater if tubing is used as a connection.

The gas iron, for domestic use, must have a burner which will burn all the gas conducted to it, and be entirely free from odor. The heat from burners must be distributed evenly over the bottom of the iron, and the tips of flame must not have any opportunity to leave the iron through side ports. If a valve for control of the flame is part of the goose neck of the iron, it should be so made that it will not shut off the gas entirely. The tube connection to be metal to metal when metal tubing is used; the surface of iron to be finished as smooth as possible, as one of the best selling points is the absence of roughness and stickiness of the ironing surface; the handle should be insulated so as to remain cool when in use.

We are indebted to the Chicago Iceless Refrigerator Company for the following data with reference to this method of using gas to take the place of the ice man. There has recently been developed a refrigerating machine in which gas is the essential feature. It consists of a generator-absorber and a condenser, with the neceesary pipe connections to and from the ice-box. The machine is operated by gas and water automatically; charged with ammonia, and being once charged will run indefinitely without recharging. Its operation is as follows: The generator absorber is partially filled with aqua ammonia and is heated by a gas flame. The heat liberates the ammonia from the water, the ammonia liberated passes over the condenser, which is a steel shell submerged in cold water. The ammonia gas gathers in this condenser until it is liquified by the pressure and the cooling effect of the water surrounding the condenser. The gas flame is then automatically turned off, and water allowed to flow over the generator-absorber. The liquid ammonia is then allowed to pass through ¼" pipe (Shelby tubing), leading to the coils of larger pipe (also Shelby tubing) in the refrigerator. These coils are immersed in steel tanks, open at the top and filled with brine. The liquid ammonia, upon reaching these coils, evaporates, and in expanding chills the brine. This process brings the brine to a very low temperature, and the sides of the brine tanks become quickly coated with frost from the moisture in the air that comes in contact with the tanks. The result is that the air of the refrigerator is not only chilled, but is kept dry which is of great advantage in the preservation of foods. The ammonia having expanded into a gas, is now passed back to the generator absorber, which has been chilled by water, and is absorbed into the water again, forming aqua-ammonia. After the ammonia is re-absorbed in the water the gas is automatically turned on again, and the cycle repeated.

In each cycle the charge of ammonia is driven out of the water by gas heat, liquified in the condenser, evaporated or expanded in the brine tank coils, and re-absorbed in the water which remains in the generator-absorber. The driving off of the ammonia by the gas flame usually takes from 40 to 60 minutes. The re-absorbing of the ammonia in the water takes from ½ to 1½ hours, depending upon the amount and temperature of the water flowing over the generator absorber. This last operation is one way of regulating the operation of the machines. It is obvious that the more water allowed to flow over the generator absorber during the re-absorbing period, the faster the ammonia gas will be absorbed by the water in the absorber. The quicker this is done the more cycles per 24 hours the machine can complete. As every cycle has a certain refrigerating effect, it follows that as the number of cycles is increased, the lower will be the temperature maintained in the refrigerator. This process is known as the gas absorption process, and is an old established method of obtaining cold. It is used in the Zicer machines because it lends itself to small refrigeration work better than the compression process. In the latter the ammonia gas is compressed by a pump into the condenser and there liquified. Any work using the equivalent of the melting of 1 ton of ice per day of 24 hours is called small refrigerator work. Some of the advantages of the Zicer machines are that they are automatic, cost less, are cheaper to operate are noiseless, have no motors, pumps, bearings, stuffing boxes, shafts, pulleys, bolts or gears to adjust or to oil and keep clean. In fact, the Zicer has no moving parts at all, does away with the necessity of hand operation and attention of an engineer, the cost of which is prohibitive in small refrigerating work. Various gas absorption machines, hand operated and non-automatic have been on the market, but we have never seen one in successful operation. Regarding the safety of these machines, the principal danger theoretically would be that the bursting of the generator absorber, the condenser shell or the piping, would allow the ammonia to escape, with the result that some one might be overcome by the gas. In the first place, the machines being small, do not use enough ammonia to endanger life. The highest pressure on the system occurs at the end of the driving off period, and at that time all the ammonia is in the shell condenser, which is surrounded with more than enough water to absorb any leak no matter how serious. The pressure at this time is about 160 pounds. The shell condenser and the generator-absorber are tested to 2,000 pounds per square inch, and the Shelby tubing will stand a pressure of over 10,000 pounds. The city of Chicago has made a ruling of no inspection for Zicer machines, which shows its complete safety. The machines are made in three sizes at present, later there will probably be two more sizes. The machine with a capacity equivalent to the melting of 150 pounds of ice per day of 24 hours, is suitable for the ordinary house refrigerator. The cost of operation depends upon the service required and the price of gas, but the average cost would be $7.50 to $10 per month with $1 gas. Another machine has a capacity equivalent to the melting of 350 pounds of ice per day of 24 hours, and is suitable for a large house refrigerator of say 70 cubic feet inside measurements or for three apartments, each having a box of about 20 cubic feet capacity. It is also suitable for chef's cabinets, or any refrigerator of that size, or soda fountains. The average operating cost with $1 gas would be $12.50 to $17.50 per month. The third size has a capacity equivalent to the melting of 750 pounds of ice per day of 24 hours, suitable for a box having a cubic content of 800 to 1,000 cubic feet, such as a butcher's box, etc. It also will operate six apartments, or a drinking water system, soda fountains, etc. The operating cost would be from $25 to $31 per month, with $1 gas. Those machines can be connected to any good box. The better the box, of course, the better the service. The best insulation is cork board, but other insulating materials are good. Most insulating materials are rendered inefficient by moisture, and the use of ice pro-

duces moisture, but the gas machine avoids this trouble. These machines have been given very thorough test in Chicago, and some other cities, and are giving satisfaction. The operation of the machine is entirely automatic, requiring very little attention from the user.

Although the manufacturers of domestic gas appliances have made many improvements, both in design and economical operation, there is room for further development, especially in the line of a more efficient burner.

One manufacturer is experimenting on a surface-combustion burner which can be used in the average home, and if a satisfactory burner of this type is developed, it will, no doubt, prove a very popular and economical method of consuming gas in domestic appliances.

Ceria Mantles as Heat Radiators.

In the "Journal des Usines à Gaz" M. L. Bertin discusses the use of mantles as heat radiators. The object when using them is the converse of that of the lighting mantle, being to convert as large as possible a proportion of the energy provided by combustion of the gas into radiant heat energy, none of it being wasted in producing illumination. The only practical solution of the problem, so far, has been the use of mantles made of ceria, Ce_2O_3. It would be a great advantage to find an outlet for the ceria residue from monazite sand which is accumulating from the extraction of thoria for Welsbach mantles. Rubens has shown that the ratios of the amount of radiation given off by a mantle to that which would be given off by a perfect radiator (black body) for the respective wave-lengths are as follows:

Wave Lengths. μ		Welsbach Mantle Per Cent.	Cerite Mantle Per Cent.
0.45 indigo	visible spectrum	86.	100
0.50 green	visible spectrum	72.	100
0.55 yellow-green	visible spectrum	40.	100
0.60 orange red	visible spectrum	24.	100
0.70 extreme red		6.2	93
1 00		1.8	35
1.50		0.9	18
2		0.7	22
3		0.8	18
6		2.7	16
8		20.	42
10		52.	84
15		79.	100
18		81.	88

The radiation of heat from the cerite mantle is below that of a perfect radiator, but is greater than that from a Welsbach mantle at the same temperatures. In the visible spectrum the cerite radiates appreciably as much as a perfect radiator would; and also in the extreme infra red. A cerite mantle in a bunsen flame does not rise in temperature beyond 1,300°, while a mantle of pure thoria reaches 1,900°, and a Welsbach mantle 1,800° (absolute.)

M. Féry has compared the radiations from different oxides at different temperatures. The results given in the table following are comparative:

Temperatures. Deg. C.	Chromium Oxide Cr_2O_3	Lime.	Thoria. Oxidizing Flame.	Thoria. Reducing Flame.	Ceria. Oxidizing Flame.	Ceria. Reducing Flame.	Welsbach Mantle. Oxidizing Flame.	Welsbach Mantle. Reducing Flame.
500	26	14	7	....	....	....	6	12
600	44	21	10	....	....	....	10	16
700	68	31	15	....	....	....	16	22
800	100	45	21	....	28	104	20	30
900	138	64	28	18	58	140	30	50
1,000	188	84	50	24	103	200	46	75
1,100	252	110	56	30	172	290	70	116
1,200	334	148	78	38	278	404	108	166
1,300	437	220	108	50	....	....	150	240
1,400	564	400	142	69	....	....	208	354

The radiation from ceria is greater in a reducing flame (red coloration) than in an oxidizing flame (greenish-blue coloration); the contrary is the case with lime and thoria. In a reducing flame the radiation is greater than that of a perfect radiater of the same temperate; compare with chromium oxide, which acts much like a perfect radiator. The radiation is most intense at the tip of the inner cone of a bunsen flame.

M. Bertin finds that a flask of water is heated more rapidly over a Welsbach mantle (artificial silk) than over a ceria mantle, the products of combustion being hotter with the former. On the contrary, if placed at the side, the ceria mantle warms the flask of water more rapidly because it radiates heat more powerfully than a Welsbach mantle, and this explains why the products of combustion are cooler. Measured with a thermopile, the heat radiations from a ceria mantle are 70 per cent. greater than those from a Welsbach mantle.

The Delage radiator consists of 6 mantles of knitted asbestos coated with ceria. Fig. 1 gives curves (*I*) for the bare bunsen flame, (*II*) for the Welsbach mantle, and (*III*) for the ceria mantle.

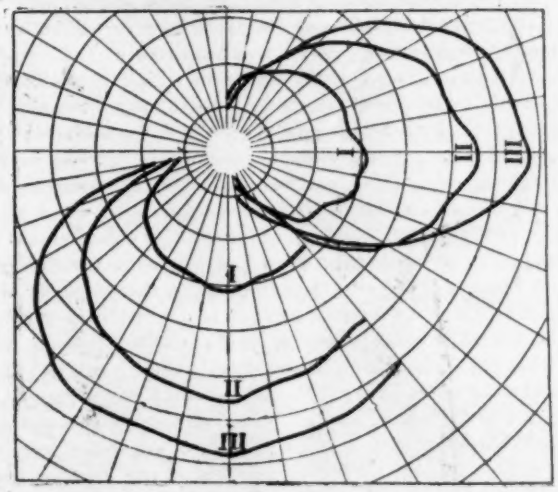

Fig. 1.

Fig. 2 shows the respective amounts of heat radiation from the bunsen flame, the Welsbach mantle, and the ceria mantle (expressed in degrees of the galvanometer deflection) from minute to minute after lighting.

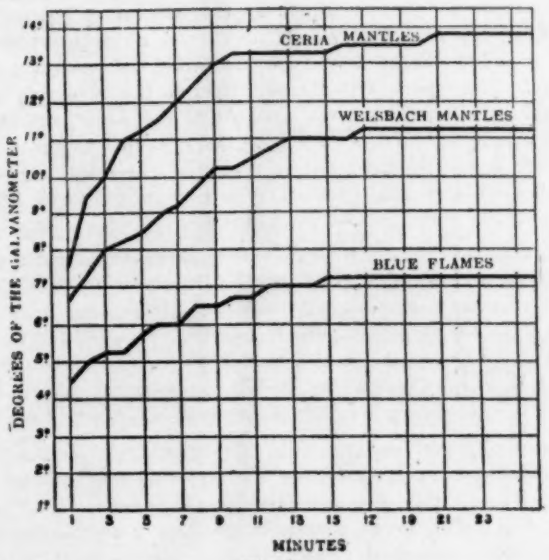

Fig. 2.

The temperatures of the products of combustion were 179° C. for the ceria mantle, and 197° C. for the Welsbach mantle, showing that the heat is better distributed by the ceria mantle. The red color of the mantles indicates that they are immersed in the reducing zone of the flame, where the radiation is most intense.

Standards for Gas Service.[1]

[Published by permission of the Director, Bureau of Standards, by E. B. Rosa and R. S. McBride.]

The article by Mr. Jacques Abady criticizing the Bureau of Standards' Circular No. 32, entitled "Standard Regulations for Manufactured Gas and Gas Service," shows a serious misunderstanding of the American conditions as well as an apparent ignorance of the method followed in the preparation of this Circular. His criticisms make very interesting reading, but most readers will agree with the editorial comment of one of the American journals, as follows:

"There is some merit in Mr. Abady's article, but we are not inclined to accept our English friend too seriously. As a gas writer,

1. Mr. Abady's article was originally published in the *Gas World*, London, for January 31, 1914, and was reprinted by the American Gas Light Journal, February 6th.

Mr. Abady may be a good lawyer. He might do better as an author if he tried to be fair and dignified, rather than cutting and facetious."

While many of his criticisms are due to differences of opinion, and others arise from lack of knowledge of American gas making conditions, in some instances his statements are erroneous as to matters of fact, and engineering and scientific facts are the same on both sides of the Atlantic. It is not desirable to enter into a lengthy discussion of those questions which are admittedly matters of opinion, but we wish to indicate certain points on which Mr. Abady has misquoted or mis-interpreted statements made by the Bureau, and to point out certain technical facts on which Mr. Abady is clearly in error.

Mr. Abady does not really discuss the merits of the various questions touched. In many cases it is impossible to determine how much of his argument he intended to be serious and what was merely sarcastic exaggeration. In other cases the conclusions which he expressed have no connection with the premises which he assumed correctly enough. We shall not undertake, therefore, to reply to his observations except in a few cases; it is desired rather to point out how the Circular was prepared, so that those interested may better judge what confidence should be placed in the Circular. The Bureau was fortunate in securing the very cordial co-operation of many American gas engineers, and to this co operation the success of the Circular is largely due. A large number of engineers were consulted in personal conference by representatives of the Bureau, and practically every state commission, which had been engaged in the work taken up by the Circular, was consulted before the first edition was issued, as were also over half of the gas companies in the United States, whose annual sales are more than 500,000,000 cubic feet. And in the preparation of the second edition, and during the revision for the third edition, a considerable number of the others were consulted. The Bureau was greatly aided by the official co-operation of the American Gas Institute, which appointed a special committee to advise with the Bureau in the preparation of the second edition of the Circular. The report of this committee, at the 1913 meeting of the Institute, indicates the general attitude of the American gas engineers, showing a few points on which the committee was of different opinion from the Bureau; but it includes the following two state ments, which show that these differences were not to be regarded as destroying the usefulness of the Circular:

"It is evident that the Bureau of Standards have spent much time and care in preparing this circular, and the thoroughness of its work is apparent to anyone who will take the time to read it carefully."

"We wish to compliment the Bureau of Standards on the comprehensive study which the subject has received, and we believe that the publication of the Circular will assist both State and municipal authorities in draughting intelligent and reasonable regulations."

In consulting with so large a number of gas engineers and officials engaged in gas inspection work, many differences of opinion were encountered. It was, of course, impossible to reconcile all these differences, but the causes of serious differences were often ascertained, and they often vanished after full discussion. In some cases two different opinions on the same subject were presented in the Circular, together with the views of the Bureau as to which was to be preferred. This may have led some to think that the Bureau had assumed to be a final authority on these matters. What the Bureau did, however, was to weigh the evidence presented and express its opinion as to the right conclusion.

The rules proposed must be judged in the light of the discussion. For example, the discussion makes very clear that although the Bureau expresses a preference for the rating of gas on the basis of the cubic foot measured under average local barometric pressure, nevertheless, an alternate form of regulation is offered. The Bureau expressed itself as in favor of rating the gas upon such a basis that the relation between the heating value per cubic foot delivered to the customer and the heating value used in the testing should be made clear. If the basis of measurement for testing and for selling are not the same, this should be made clear by the regulations. As stated in the Circular, it seems better that the methods of measurement for the two purposes be the same; but the Bureau does not, as some have supposed, insist upon one method or the other. This should be clear from the fact that an alternate form for the rule on this subject is given. (See pages 109-110 and page 114 of the second edition of the Circular). The question as to what cubic foot should be used for measurement of gas is the point most frequently discussed by gas engineers in connection with the Circular, and it may be desirable therefore to state again the attitude of the Bureau on this subject. At the present time gas is measured to the customer at the temperature and pressure existing in his meter. The temperature in different customers' meters is, of course, different, and since it is impracticable to determine the mean temperature, a standard temperature of 60° Fahrenheit is assumed, which is as near as possible to average conditions. The Bureau has seen no reason to suggest a change from this practice.

The pressure of the gas, on the other hand, is practically the same in all customers' meters in any city, since the difference in pressure from atmospheric in different customers' meters is so small as to be a negligible part of the total. It is possible, therefore, to select for any city a pressure which will be practically equal to the average pressure at which the gas is metered to every customer throughout the year. Such pressure may be termed the local average gas pressure. If the gas were measured for the purposes of testing the quality at this same pressure, then the average foot of gas measured to the customer would contain as many heat units as the rating of the gas would indicate. That is, 600 B.T.U. gas would contain on the average 600 B.T.U., and not some other number. So far there is no difference of opinion as to the facts. The point on which difference of opinion exists is as to whether or not it is desirable to rate the gas upon this basis.

Mr. Abady and some other engineers have referred to the cubic foot of gas defined on this basis of the local average pressure as an "elastic cubic foot" or an "artificial cubic foot." The cubic foot used for measurement of gas to the customer is, of course, elastic in the sense that it differs in one locality from the cubic foot in another, but this condition cannot be remedied by any method of definition, since the cubic foot of gas will always vary if the barometric pressure varies. At an altitude of 5,000 feet it is only five-sixths of the normal value. It becomes then a question as to whether or not it is desired to have the cubic foot for purposes of testing electric, in the same sense and to the same degree, as the cubic foot for purposes of measurement to the customer is elastic. In other words, do we wish the cubic foot to be different in selling from what it is in testing for the same city; or, is it better to have it the same for both testing and measurement to the customer, even though it differs in one city from another? The Bureau has expressed in Circular No. 32 the opinion that it is better to have the cubic foot the same for both purposes in any one city, in the following words:

"Having carefully taken account of all of the factors affecting this matter, the Bureau recommends that the rating of the quality of the gas be so made that both its average actual heating value and the heating value reduced to 30 inches of mercury pressure be stated, the first being given greater prominence. In the many places where no heating value rules are in force, this system can be used when rules are adopted; where regulations are now in force a change to this basis of rating should be carefully considered at the next favorable opportunity."

From this it is evident that the Bureau recognized the fact that the custom of using the standard cubic foot for purposes of testing is so firmly fixed in American practice that in many cases it may not be thought practicable to make a change at the present time. If the change is not desired, it will only be necessary to follow the alternate form of rule proposed by the Bureau. We find no justification for Mr. Abady's statement that rating the gas on the basis of the cubic foot of gas under average local barometric pressure "in the way it is applied to testing * * * is not even accurate or scientifically correct." Gas tests can, of course, be rated on that basis as accurately and as scientifically as on any other basis, the only question is whether or not it is desirable to do so.

Mr. Abady also reaches the conclusion that, since the consumer "never has, never can and never will" get 600 B. T. U.'s and 16 candles from a gas testing 600 B. T. U.'s and 16 candles, he is not interested in the results of the tests. It is a fair assumption that he will utilize about the same percentage of the total heating value of gas of any quality commonly supplied if he uses the proper appliances; he is certainly, therefore, interested in the rated heating value of the gas delivered to him. Mr. Abady says, "I formally demur to the statement 'that the actual candle power of the gas delivered should, if possible, be the basis of rating on the same basis that the actual heat delivered should be the basis of the heating value to be specified.'" Here again it is not a question of what Mr. Abady would personally prefer, but it is a question of actual conditions encountered in American practice, where many cities have adopted

ordinances requiring the *delivery* of gas having a specified candle power.

One subject not touched upon by Mr. Abady, but one quite pertinent to this discussion, is the engineering significance of the correction of gas volumes when calculating either "gas unaccounted-for" or "yields" per pound of coal, or per gallon of oil. In the first of these calculations, it is necessary to have the station meter and the total of customers' meters readings on the same basis; and there is no reason why this basis should not be the average local pressure. In other words, there is no reason why either "sales" or "make" should be corrected for pressure when computing leakage; and no such correction is made by many companies. If, in determining the B. T. U. obtained in the gas per pound or per gallon of fuel used (*i. e.*, the yield), the gas per unit of fuel is measured and its quality is rated by the test at the average barometric pressure, the product of this volume by this quality rating gives the yield as correctly and at least as conveniently as would be possible if both volume and quality were on a "standard pressure" basis. The Bureau has failed to find any case where engineering comparisons, made as they should be on the basis of B. T. U. obtained per pound of fuel, are not as easy and as significant when using the cubic foot measured at local barometric pressure. However, the Bureau has never suggested that a company need, unless it wished to do so, keep its operating records on any new basis; the basis for rating of quality in the matter of public relations, is the question that is of primary interest to the Bureau.

In discussing the effect of barometric pressure on candle power, Mr. Abady makes it very evident that he is not familiar with the fact, known to American gas engineers, that it is possible to obtain a greater number of candle-feet per gallon of oil at high altitudes than at low altitudes, when candle power is measured against a pentane lamp and reduced in accordance with the current method of calculation. The evidence which has been submitted, and there is a great deal of it, indicates that if the same gas were tested against a pentate lamp at a high and at a low altitude station, and the results of the tests were calculated by the usual method, the test at the high altitude station would give the gas a considerably higher candle power rating. The method of making this calculation is explained in the next paragraphs. That such a condition exists, is evidence that the question is a practical one, and the cause of the difference should be ascertained and the method of calculating the results of the tests modified to suit the facts. Mr. Abady basis a long argument on what he says the Bureau admits, viz.: "That the gas flame and the ten-candle power (pentane) lamp are probably affected equally by changes in atmospheric pressure." If anyone will refer to this statement in the Circular in connection with the context, it will be evident that the statement was applied to the effect of small variations from the average atmospheric conditions prevailing at any one locality. On page 40 the Circular goes on to say, "It has been wrongly assumed that the present method of correcting candle power measturements gives to a gas a definite candle power value regardless of the conditions at the time of test. As far as the effect of humidity is concerned, this assumption is nearly, if not exactly, correct; but in the case of variations of pressure, it is not true."

Experiments carried out in the photometric laboratories of the Bureau and in Europe show that the pentate and the Hefner lamps are affected quite differently by changes in atmospheric pressure, and it is quite possible that a difference may also be found for the open-flame gas burner. This is a matter to be settled by experiment, as is now being done; in the meantime it is not safe to say, as Mr. Abady does, that "the causes which are depreciating the flame value of the 10-candle lamp are depreciating, to an absolutely equal extent, the flame value of the gas flame."

In order to make clear the physical significance of the customary method of calculating candle power test data, let us assume that this statement of Mr. Abady's is correct. The case can be illustrated as well on this assumption as any other:

Let us take a gas having an actual candle power of 15 when burned at 5 cubic feet per hour under 30 inches pressure and at standard temperature and humidity. When the gas flame is compared with the 10-candle pentane lamp under these conditions, it would be found to have 1½ times the value of the standard; and the gas would, therefore, be rated as of 15 candle power—quite correctly, as everyone will admit. Then let us burn this gas at some lower pressure, say 25 inches, still maintaining the gas rate of 5 cubic feet per hour under this new condition. If Mr. Abady's assumption be correct, the *ratio* of the *actual* candle power of the gas flame and the *actual* candle power of the pentane lamp is unchanged by the change of pressure; or, in other words, we should still find the gas flame in lighting value 1½ times the pentane flame. Under 25 inches pressure the pentane lamp has about 90 per cent. the normal value, or 9[1] candles. The actual lighting value of the gas flame would be, following the assumption made by Mr. Abady, 1.5 times 9.0 or 13.5 candles. By the customary method of candle power testing the pentane lamp is called 10 (or other value found for normal pressure) regardless of the pressure. The gas flame having 1.5 times the value of the pentane flame, would be called 15 candles uncorrected; and this value would be corrected for the effect of pressure on gas volume, in the present case the correction factor being $\frac{30}{25}$. The calculation would, therefore, be as follows:

10 (the value of the standard) x 1.5 (the ratio of the standard to the gas flame) x $\frac{30}{25}$ (the ratio of normal pressure to actual pressure on the gas as metered) = 18.0 candles.

It will be seen, therefore, that a gas which was actually giving 13.5 candles would, under present methods of rating, be called 18-candle power; and further, if Mr. Abady's "absolutely equal" assumption be true, a gas which is rated at 15 when tested at sea level would be rated at 18 when tested at the higher altitude.

This calculation serves to show how it is customary to make gas candle power tests at the present time. We shall return to this subject a little later, but it is necessary here to re-emphasize only this fact established by engineering results in America, namely: That the present system of calculation does tend to give higher rated values for the same gas whenever the barometric pressure is less than normal; instead of giving, as is often supposed, the same rated value for the gas regardless of barometric pressure.

One other point on which there is difference of opinion is as to when, or under what conditions, the candle power requirement is necessary. American regulations have been, in general, in advance of the English regulations in changing from a candle power to a heating value specification as the primary requirement. The Bureau is in thorough accord with this tendency, as is made very clear in the second edition of Circular No. 32.

The proper value to be fixed either for a candle power or a heating value specification depends largely upon local conditions. However, the Bureau has found less variation necessary than some have supposed. One of the members of the American Gas Institute Committee, appointed to confer with the Bureau in the revision of Circular No. 32, writes as follows;

"However, we recognize clearly the fact that you (the Bureau) must make some general statement that will approximately fit average conditions, and the 600 heat unit statement with the qualification that leeway must be given in the heating value regulation for the use of the most economical raw material for the manufacture of gas which is obtainable in the district under consideration, in order that the company may serve and the people may obtain the greatest amount of heat for the dollar expended, perhaps comes nearest to doing this. Personally, I do not see why the Bureau should be afraid to make a general statement of that kind, knowing that it is absolutely sound, and then leave the details of the determination of what should be accorded in each case to the local authorities, or to the State commission, as the case may be, to determine after hearing all the facts in the case."

The Bureau has made its recommendations on this basis, and has carefully emphasized the fact that in no locality should the figures named be adopted unless consideration of local conditions justify.

Mr. Abady asks why the Bureau recommends a higher heating value for water gas than for coal gas. The reason is that the economic considerations indicate greatest economy with water gas with a higher heating value than happens to be best for coal gas. Each value is fixed independently, and the relation between the two should not be considered of any significance in consideration of the relative usefulness of the two gases. For special applications of gas it is true that a lower heating value gas may be more useful per heat unit than gas of higher heating value, but under average conditions of utilization no such generalization is warranted, and the Bureau would certainly reiterate the statement which Mr. Abady has criti-

1. This result was recently obtained in the photometric laboratories of the Bureau of Standards. The value given by Butterfield, Holdane, and Trotter (*Journal of Gas Lighting*, 115, p. 288, 1911), is about 8.7 candles.

cized, viz., that a drop of 10 per cent, in heating value should be accompanied by some drop in price.

Mr. Abady, and perhaps other English readers of Circular No. 32, have difficulty in understanding the complicated inter-relation of Federal, State and city authorities governing the public utilities operations in the United States. It must be understood that the Federal authorities have no power of regulation over the operations of gas companies, since practically none of them carry on an "interstate" business. In most cases the State authorities have power to supercede or set aside the action of the municipal authorities, although this is not the case in States where the constitution of the State or the charter of the cities grants full authority to the municipal bodies. These complicated conditions make it practically impossible for any one authority, or any group of authorities, to carry out a systematic scheme of gas company regulation for all the country. The Bureau's effort has been directed to the standardization of the State and municipal operations in this work in the hope that, although occupying only an advisory positition, its recommendations might tend toward greater uniformity of specifications, and lead to more thorough technical consideration of the questions involved.

It has been the intention of the Bureau to base its recommendations upon the regulations now in force in this country. That this should be done is eminently proper, and in this respect we would entirely agree with Mr. Abady. However, a consideration of the laws now in force, and many regulations proposed for adoption, will make clear why the Bureau finds it impossible to base any recommendations wholly upon the laws or rules in force. Mr. Abady himself brought out the fact that these laws are irregular in form and differ greatly in different localities. He, however, overlooked the fact that most of the proposals of the Bureau are not novel, but correspond with regulations which have been found in practice to give the best results. Indeed, the effort of the Bureau has been to recommend such regulations as have been shown by experience to be practicable and satisfactory. The Bureau thus reflects the best opinion of the industry, and supports those measures which may be expected to give the best results.

Mr. Abady's conception of the object of gas testing, is expressed in the following quotation, and goes far to explain his attitude toward the Circular:

"Surely the object of a test is merely to establish a basis of quality of supply in relation to price as between the company operating the monopoly and the local authority representing the public. It is not, and cannot possibly be, the basis (or any part of the basis) of a contract between the company and the consumer; a company's engineer does not say to a consumer "I will supply you with 600 B.T.U. for 1 cent." He says, "I will supply you with so many cubic feet of gas for $1;" and if the consumer asks "What gas?" He is naturally told, "Gas of quality prescribed by the city and tested by its appointed officials."

If it were true that the relation of quality of supply to price is determined by the company and an official familiar with the technical matters involved, and that the public, *i. e.*, the consumers, do not concern themselves with the amount of heat obtained for $1, Mr. Abady's view of the uselessness of a local pressure standard of measurement would be easier to justify. It would be of less consequence what conditions were chosen as standard, because everyone who was in any way concerned with the testing would be familiar with the results of the tests and their meaning in any case. But in this country, at least, the "local authority representing the public" is not free to "establish a basis of quality of supply in relation to price" as he chooses. On the contrary he is theoretically, and very often actually, only the instrument through which the people make their agreement with the company, and he must act, not in accord with his own judgment, but with that of the majority of the voters. In many cases, the people vote upon and decide directly what conditions shall govern the relations between the company and the customers. It might be assumed that the people would not interest themselves in such technical matters and would leave their settlement to qualified representatives; but the great number of elections in which some phase of public utility regulations is the principal issue, shows that this is not the case. If anyone imagines that the consumers are interested only in "how many cubic feet they get for a dollar" and not in "how many B. T. U.'s they get for a cent," a perusal of some of the correspondence which reaches this Bureau would materially change his opinion. Since the general public cannot be expected to understand in detail the factors affecting the relation of price and quality of gas, their judgment is largely affected by conditions prevailing in other cities; and a method of rating heating value which expresses heat obtainable from a cubic foot as sold to the customer, the only cubic foot in which the public is interested, is of considerable importance in making such comparisons. Recognizing fully the disadvantage which results from comparison of standards or comparison of rates between the various cities or States, the Bureau still appreciates that these comparisons will be made, and realizes that it may be desirable to anticipate the comparison by eliminating in so far as is just and fair, the chance for unfavorable criticism of any party involved. In any case where the regulating authority can, without injustice to the public or to the company, fix a standard or a rate similar to the standards or rates in force elsewhere, so long there is some advantage inherent in this particular standard or rate.

In any case where a heating value specification is adopted, the question may be raised as to the fairness of the heating value standard set; especially if it were fixed lower than 600 B. T. U., since 600 is a very common standard in the requirements now in force. It would then be necessary to present to those raising this objection some conclusive evidence that the decision was correct. If the evidence were conclusive then proper publicity and frank presentation of this evidence to the public should, and in most cases would, be sufficient. On the other hand, the mere statement that it seemed preferable to fix a standard lower than commonly enforced elsewhere, would not ordinarily be enough. The average customer appreciates and recognizes the fairness of the statement that he can obtain more for his dollar with a poorer quality of gas, if this be the fact; but this same customer is hardly content to take a poorer quality than the customers in the neighboring states or cities receive, unless he is assured that he does thus get more for his money.

Mr. Abady quotes a portion of a paragraph from page 39 of the Circular, and comments on it as follows:

"Now, first, what justification is there for the first assumption; secondly, what justification is there for saying the actual candle power, at 25 inches pressure, will be 12.5 candles? Thirdly, what current method of calculation transforms 12.5 into 17.3 candles?"

The reply to the first question is in the very next paragraph of the Circular, a part which Mr. Abady did not quote, perhaps since it would have destroyed the whole force of his comment. It is as follows:

"Probably neither of the above assumptions as to the luminous efficiency of a gas flame, with varying barometric pressure, is exactly correct; but the conclusion is trustworthy, nevertheless, that the present method of computing candle power from the observed data is unsatisfactory, in that it does not show directly by the result of a test the amount of light given by the test burner, either under the conditions of the test or at sea level. Nor does it show the luminous power of the gas under any particular conditions."

In referring to the matter of calculating the results of the candle power tests (the second and third queries just quoted) Mr. Abady has criticized the statement of the Bureau showing the relation between actual light given by gas burned at 5 cubic feet per hour and the rated candle power ascribed to this gas by present methods of computation. We have carefully gone over this calculation which was carried out as described earlier in this article, and we find no error in it. The Bureau did not state that the test referred to (see page 39 of the Circular) was assumed to have been made with a pentane lamp; it is clear, however, that Mr. Abady was not mislead by the omission of this statement, since he refers to the pentane lamp as being the standard used. He states that "I did many thousands of calculations in connection with these correction tables;" but it would seem that Mr. Abady must have failed to appreciate the physical significance of the arithmetical procedure which he followed in his work. The present method of calculating candle power data does not give the same value for any particular gas, when this gas is tested under different barometric pressure conditions. If the candle power of a gas flame burning a constant mass of the gas per hour were affected in the same proportion that the standard flame is affected, when operated at constant flame height, then the ratio of the two flames so operated would be constant, regardless of pressure; and if, in addition, the candle power of the gas flame varied directly in proportion to the mass of gas burned per unit of time, then the present system of computation would give the same value, regardless of the barometric pressure at the time of the test. As a matter of fact, as has been stated above, the present system neither gives the

same value for all pressures, nor the actual value under any pressure, except at sea level. It is this irregularity in the significance of a test that makes the present system of rating so unsatisfactory.

Mr. Abady has undertaken to criticize the proper heating value standard on the basis of certain English operating results which he quoted. He states that certain claims as to the relation between candle power and heating value are impossible, using for his evidence summaries for 5 years from the city of London. The Bureau had already seen the data which Mr. Abady quotes, and had deemed it of considerable interest in the present case; but the results are scarcely applicable under American gas making conditions. This is evidenced by the fact that a large amount of data obtained from extended operation, and not from "isolated tests," show that the generalizations made in the Circular No. 32 are justified under American conditions. The Bureau is confirmed in its judgment on this point by the fact that a considerable number of American gas engineers agree entirely with the values quoted by the Bureau. The most striking difference between American and English conditions is perhaps in the matter of gas pressure regulations. The use of the individual appliance cock as the sole regulator for gas pressure would seem a novel suggestion for American conditions. It is doubtful whether any American gas engineer, disturbed as many of them are by the difficulties of maintaining what is considered a reasonable constant pressure at the customer's service, would agree with this extreme view. How to improve pressure deficiencies "in any district" within 3 months, or within any other period, "without breaking up the roads" is a difficult question. We do not understand what measures Mr. Abady would suggest unless he proposes that the sales in the district be reduced.

The stamping of gas service meters by government officials can hardly be recommended by one familiar with American conditions. It seems quite certain that Mr. Abady himself would not favor this if he were better acquainted with conditions in this country.

As an example of the misquotations with which Mr. Abady's article abounds, the following may be noted. Mr. Abady says:

"The arguments which run through pages of 'The Circular' are many and ingenious, and it is even suggested that for every 1,200 feet increase in altitude a testing ordinance should call for an extra 25 B. T. U."

As a matter of fact the Bureau states the following:

"When the heating value of the gas as delivered is the basis of rating, it is not practicable to require the same value at all altitudes even if other factors are equal. Where there is thus a considerable difference due to barometric pressure the value required may be modified; for example, it would be well to change the numerical value by 25 B. T. U.'s for 1,200 feet above sea level. For small changes in altitude, no change is necessary."

The Bureau assumed that it would be clear to any intelligent reader, even though he knew nothing of the subject before examining the Circular, that the "change" was to be a decrease not an increase.

We hope that Mr. Abady will read Circular No. 32 again, and with more sympathetic interest than before, and that others interested in the subject will also give careful attention to the circular itself before accepting such sweeping criticisms as are contained in his paper.

Somerville Process for Estimating the Sulphur in Spent Oxide.[1]

The estimation of sulphur in spent purifying material is so important in gas works laboratory practice that it seems strange so few efforts have been made to obtain a satisfactory method of carrying it out. At the present time, the carbon bisulphide process is almost universally employed. This consists essentially of the dissolution of the free sulphur in the spent oxide by treatment with carbon bisulphide. The oxide is enclosed in a glass tube, on the top of, or inside, some filtering medium; and the carbon bisulphide is allowed to drain through it into a flask, from which it is subsequently evaporated, leaving the sulphur behind. There are various kinds apparatus in use for the purpose, from a simple test tube, with a constricted open end at the bottom, to the more elaborate Soxhlet syphoning fat extractor, which is automatic in its action of repeatedly washing the oxide with the reagent. There are, however, very many drawbacks to the carbon bisulphide process, among which the following may be enumerated: (1) Time; (2) difficulty in getting perfectly clean sulphur on evaporation; (3) difference in results of repeat tests on the same sample; (4) inflammable nature of the reagent; (5) the fact that only the free sulphur is recorded. The fitting up of a Soxhlet apparatus, if not permanently fixed for daily use, takes a considerable time. This, added to the actual process of washing out the sulphur, will occupy not less than an hour, apart from the evaporation of the bulk of the carbon bisulphide from the flask into the stock bottle. Then we have the final evaporation of the last traces of the carbon bisulphide from the sulphur in the flask by means of the water oven—an operation extending over at least 4 hours, preferably 6. So that, in a matter of time, although the operator need not confine his attention to the process throughout its entire working, a very large demand is made upon the laboratory day; and where the knowledge of the condition of recently discharged purifying material is required at short notice, the process is not found very useful. The difficulty of securing perfectly pure sulphur, free from contamnation of minute particles of oxide carried through the filter with the carbon bisulphide, is not a small one; and it has been found nec s sary to take some elaborate precautions to obviate this. The oxide was washed into a filter paper cone made from a hard paper, and a plug of cotton wool placed in the top of the cone; the cone itself resting on a secondary filter of cotton wool rammed on to the bottom of the Soxhlet tube. This was found to be effective where ordinary filter thimbles were unsatisfactory. It is a serious drawback that the total sulphur available for sulphuric acid manufacture is not recorded by the process, as such information on the quality of spent oxide and the amount of residual sulphur in the burnt oxide is eminently desirable.

Consideration of the points led Mr. Somerville to regard the carbon bisulphide process as unsatisfactory, and investigations were made in other directions to design a better one. Such processes as the direct conversion of the sulphur into sulphuric acid by oxidation with nitric acid and potassium chlorate, potassium hydrate, and hydrogen peroxide, and similar reagents for the purpose, were not completely successful. The possibility of converting the sulphur into sulphur dioxide by combustion and absorbing the products for estimation, either gravimetrically or volumetrically, was tried, and eventually adopted as being the only method which satisfactorily fulfilled what Mr. Somerville considers should be the three pre-eminent qualities of any laboratory process—*i.e.*, accuracy, rapidity, and simplicity.

The process consists in igniting the oxide in a stream of oxygen and obsorbing the products in an alkaline solution containing a known weight of the alkali. By this means the sulphur dioxide, from a known weight of oxide, is converted into a sulphite of the alkali used, and a portion, or the whole, of the solution is oxidized to sulphate by the addition of hydrogen peroxide. Thus the solution containing the sulphate may be estimated either gravimetrically as barium sulphate, or volumetrically by titration with an acid of corresponding strength. Using sodium hydrate for absorbing the sulphur dioxide, the following reactions occur:

1.—Ignition. $S + O_2 = SO_2$

2.—Absorption. $SO_2 + {}_2NaHO = Na_2SO_3 H_2O$

3—Oxidation. $Na_2SO_3 + O = Na_2SO_4$.

The volumetric method of estimating the amount of sulphate produced is to be preferred; and for this purpose methyl orange must be used to indicate the solution, as it is obvious that some of the sodium hydrate will be converted to carbonate by the CO_2 generated in the combustion of the organic matter in the oxide. In brief, the precedure for estimating the sulphur is as follows: The oxide is contained in a porcelain crucible placed in a suitable glass vessel—the design of which is of some importance—containing inlet and outlet tubes for the passage of the oxygen.

The vessel is connected by its inlet to an oxygen generator or bottle, and by the outlet to a gas washing bottle containing a measured volume of standard sodium hydrate. The stream of ogygen is started, and the oxide ignited. Combustion being maintained, the products are carried into the gas washing bottle, where the SO_2 is absorbed, When the combustion is complete, and the absorption of all products insured, the contents of the bottle are made up to a known volume. A portion of this is treated with sufficent neutral H_2O_2, indicated with methyl orange, and titrated with standard HCl or H_2SO_4. From the volume of H_2SO_4 thus obtained, a simple calculation gives the equivalent weight of sulphur and its percentage in the oxide.

(*Continued on page* 378.)

1. *Journal of Gas Lighting*, London.

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NEW YORK, MONDAY, JUNE 15, 1914.

DEATH OF JOHN P. HARBISON.

General John Pooler Harbison, the last of the male members of a family for many years prominent in the affairs of the State of Connecticut and the city of Hartford, died the 5th inst., at his home, No. 102 Vernon street, after an illness of many months. He was a former quartermaster general of the State, having been appointed by Governor Morris, and for nearly half a century was connected with the affairs of the Hartford City Gas Light Company, first as clerk, later as secretary and then president. His illness dated from about a year ago, when he was forced to give up his active life. At times, since then, his strong will had caused him to injure his physical weakness, and he had been present at meetings held to discuss public questions. One of his last acts was the gift of the John P. Harbison playground, and the Harbison Memorial Hall, to the city.

General Harbison was born in the county of Armagh, Ireland, June 11, 1837, a son of Robert Harbison and Mary (Anderson) Harbison. He received a good education in the private and public schools of his native country, and at an early age moved to Belfast, where he was employed in the linen manufacturing business. In 1849 the family came to this country, settling in Hartford about 1850. In December, 1855, he accepted a clerkship with the Hartford City Gas Light Company; 9 years later becoming its secretary, and in 1879, its treasurer. In January, 1900, he advanced to the presidency of the Company, succeeding the late Lieutenant Governor, J. L. Howard. In 1903, when the Hartford Gas Securities Company was formed to take over the stock control of the Hartford City Gas Light Company, General Harbison declined to continue in office and was succeeded by Judge E. B. Bennett.

Besides his office duties, General Harbison, while connected with the company, took an active interest in the outdoor work, and was instrumental in the laying of miles of pipe to supply the people of the city of Hartford. Some idea of the growth of the company during his service may be gained from the fact that, when he entered its employ in 1855, only 600 tons of coal a year were used. He was known as an expert in the handling of workmen and accomplished a great amount of work in a short space of time. He was prominently known in gas circles outside of the city and was a former president and vice-president of the New England Gas Associrtion. He was also a member of the finance committee and later president of the American Gas Light Association, and an honorary member of the Western Gas Association and the Ohio Gas Association.

General Harbison was an interested observer of affairs in public life, and for some years the public hearings in City Hall, or the meeting of the Landlords and Taxpayers' Association, or the Hartford Business Men's Association which did not hear him was infrequent. He gave life to even an uninteresting subject and a little opposition was enough to arouse his witty tongue, and a flow of eloquence which left effects upon his opponents and many times carried conviction.

General Harbison was a fighter and he knew how to fight, being a skilled parliamentarian and having an unusual command of vigorous English, which enabled him to drive home his arguments, while few men were more expert than he in massing the facts to defend his position.

In religious circles General Harbinson was actively identified with the First Presbyterian Church for many years. He was superintendent of the Sunday School from 1863 to 1875, with exception of 2 years, and one of the ruling elders from 1863 to 1875. Of late years he had been interested in the Rose Memorial Church on Wilson Street.

He was a member of St. John's Lodge, F. and A. M., Pythagoras Chapter, R. A. M., and Wolcott Council, R. and S. M. In former years he was a prominent member of the Improved Order of Red Men, and was a Past Great Sachem of the Great Council of Connecticut.

General Harbison was twice married. He leaves three children, Mary L. F., a daughter by his first marriage, and a son, John P. Harbinson, Jr., and a daughter, Isabel Ayer Harbison, by his second marriage. His second wife, who was Miss Vida Ayer, survives him, as do two sisters, Mrs. Elizaheth H. Evans and Miss Jane Harbinson, both of Hartford.

BRIEFLY TOLD.

THE EMPIRE STATE GAS AND ELECTRIC ASSOCIATION.—The summer meeting of the Association will be held in the Fort William Henry Hotel, Lake George, on Friday, June 19th, beginning at 10 A.M. The principal subject for discussion will be "Advertising." The Executive Committee has made arrangements for a daily review of all newspaper publications of the State referring to gas and electric matters, either local or general, and in connection with this work clippings have been secured of a large number of newspaper advertisements of gas or electric companies which will be on exhibition at the meeting. It has been interesting and somewhat surprising to note the number of different purposes for which newspaper advertising is being done. Some use their space for general publicity, some for advertising their rates, some for advertising appliances and so on; and a number of the members who are using these different methods will discuss them informally at the meeting. There are a good many phases to this question of advertising and as many of them will be taken as the time will permit. If found desirable a session may be held on Saturday. Members are requested to let the Committee know promptly who will be present. Probably a good many will want to stay over night or over Sunday, and in this case they should write direct to the Fort William Henry Hotel, Lake George, N. Y., for accommodations.

ILLUMINATING ENGINEERING SOCIETY OFFICERS.—The Report of the Committee of Tellers of the Illuminating Engineering Society on the results of the recent annual election, presented to the Council of the Society, June 11, showed that the following national officers had been elected for the ensuing year: President, Dr. A. S. McAllister; Vice-Presidents for 2 years, F. A. Vaughn and C. A. B. Halvorson, Jr.; General Secretary, Joseph D. Israel; Treasurer, L. B. Marks; Directors for 3 years, Ellice M. Alger, Harold Calvert and V. R. Lansingh. The local officers are:

Chicago Section—Chairman, W. A. Durgin; Secretary, H. B. Wheeler; Managers, Harry S. Gradle, M. G. Lloyd, F. A. Pinckney, Edward G. Pratt and Herman V. Willman.

New York Section—Chairman, Norman Macbeth; Secretary, Clarence L. Law; Managers, George W. Cassidy, Norman D. Macdonald, H. B. McLean, Frank E. Wallis and Percy S. Young.

New England Section—Chairman, Louis Bell; Secretary, S. C. Rogers; Managers, C. M. Coles, J. W. Cowles, Walter B. Lancaster, H. F. Wallace and R. C. Ware.

Pittsburg Section—Chairman, G. W. Roosa; Secretary, S. G. Hibben; Managers, W. A. Donkin, H. T. Hower, Harold Kirschberg, E. B. Rowe and R. H. Skinner.

Philadelphia Section—Chairman, H. A. Hornor; Secretary, L. B. Eichengreen; Managers, James Barnes, Douglass Burnett, George S. Crampton, R. B. Ely and F. H. Gilpin.

NATIONAL COMMERCIAL GAS ASSOCIATION WILL REPEAT PRESENT COURSE.—The Board of Educational Control has decided to repeat Part 3, Utilization of Gas Appliances Course, starting September next, in order to give an opportunity to all who have not taken advantage of enrollment this year. At present 3,850 students are enrolled, a great many of whom are connected with companies where classes have been formed for study and monthly meetings of the students.

The course consists of a series of printed lessons on the following subjects:

1. Domestic cooking appliances.
2. Illuminating appliances.—supplementary paper on combustion.
3. Second lesson on illuminating appliances.
4. Circulating water heaters.
5. Instantaneous automatic water heaters.
6. Hotel and restaurant appliances.
7. Street lighting.
8. House heating and ventilating.
9. Industrial fuel appliances.
10. Window dressing and show rooms.

The unsolicited letters of commendation which have been received from individual students and from class leaders, show that this course is most valuable to the men and a means of increasing the efficiency of employees.

Enrollment in the course is on the following basis:

Members of the Association.....	$5	for entire course.
Individuals who are not members, but employed by Company members	$5	" " "
Individuals who are neither members themselves nor employed by Company members.....	$10	" " "

Companies are urged to bring this matter before their employees and to encourage them to take up this work and to form a class, even though it is only of 3 or 4 students. The first lesson will be mailed September 1st, and it is hoped to have at least 1,000 men enrolled by that time.

THE PERSONAL TOUCH.—For some time past the Detroit (Mich.) City Gas Company has been personalizing its daily newspaper advertising by inserting the photographs of the department heads of the Company, with short signed messages to the public. They have extended from the Vice-President down the entire line to the shop foreman, and even to the telephone operator. Mr. R. C. Fowler, Advertising Manager for the Company, who is responsible for this move, has collected these ads in a handsome booklet, which every gas company should see and which they can no doubt get by writing to Mr. Fowler. The Detroit *Times*, in an editorial comment on this matter, says: "It is quite the best thing we have ever known a public service corporation to do, and remarkable as coming from a public service corporation for its frankness and indicating a real desire to please its patrons. Personal service is what the gas company aims to give and a personal acquaintance on the part of customers and department heads is what the booklet aims at.

DR. ROSA AND MR. MCBRIDE REPLY TO MR. ABADY'S CRITICISM OF CIRCULAR NO. 32.—Under the title, "Standards for Gas Service," on page 371 of this number of the JOURNAL, we print the reply of the Bureau of Standards, Department of Commerce, to the remarks of Mr. Jacques Abady on the Bureau's circular on "Standard Regulations for Manufactured Gas and Gas Service." (Mr. Abady's criticism was printed in the JOURNAL of February 16th, page 103.) In sending us their reply Director Stratton of the Bureau of Standards says: "In this connection, I would state that the Bureau welcomes at all times expert criticism of, and suggestions regarding its publications. Moreover, it is extremely gratifying to note that engineers and scientific men are usually able to express their opinions and criticisms without the aid of such flippant and undignified terms as used by Mr. Abady in the article referred to." The paper by Dr. Rosa and Mr. McBride is in no sense an apology, but points out the reasons for those features of the circular that Mr. Abady apparently could not understand, and sets him right on the things he misinterpreted or misquoted.

PRESIDENT BLACKWELL'S REBUKE.—Those men who, sent to convention by their employers to gain helpful information, instead of attending the sessions regularly, go out for "a time," received a severe scoring by H. C. Blackwell, retiring President of the Iowa District Gas Association. "In many instances employees of gas companies," Mr. Blackwell said, "think they are sent to these meetings for the purpose of having a good time. These young fellows feel that they are not being watched, and being away from home, let loose. I'll venture to say that some of these young men have not been in the convention room more than 30 minutes during the entire meeting. It is all right for them to parade around at night, but I think they should be present at the sessions the next day. Salesmen from some appliance companies have a good deal to do with enticing these young men from the business meeting. I hope the members of this Association will prevail upon the salesmen to discontinue this practice and also make it a point to attend the meetings themselves for the various topics discussed are doubtless just as beneficial to them as to the gas men." Mr. Blackwell would not have spoken as he did had there not been reason for so doing, but our observation from attend ance at conventions in all parts of the country, is that the habit he complains of is becoming less common, and the men at the various state and national association meetings take themselves and their obligations too seriously for much over-indulgence.

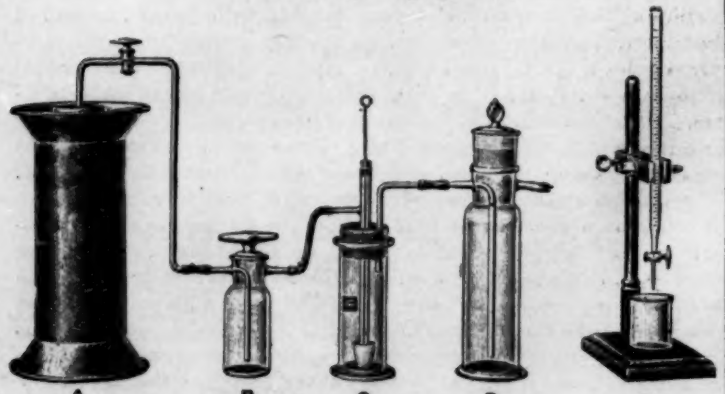
MID-YEAR CONFERENCE, NATIONAL COMMERCIAL GAS ASSOCIATION.—The first Mid-Year Conference of the N. C. G. A., was opened on Thursday morning last, with a meeting of the Board of Directors of the Association and committee meetings in the Engineering Societies' Building; and an all-day session of the Committee on Development of Industrial Fuel, in the Auditorium of the Consolidated Gas Company's Building, on East 15th street. Nearly 125 members of the Association attended the latter gathering, over which Mr. H. O. Loebell presided, to hear the industrial papers. The following were presented and read:

"Varnish Making," by Mr. J. L. Mayforth, read by Mr. Tully Wilson.
"High Speed Steel," by Mr. G. W. McKee.
"Heat Treatment of Carbon Tool Steels in Gas Fired Furnaces," by E. F. Davis.
"Die Casting," by Mr. E. C. Chapple.
"Japanning," by Mr. H. W. Karshner.
"The Electrotyping Industry," by Mr. M. Rosenberg.
"The Hat Industry," by Mr. P. M. Harris.
"The Laundry," by Mr. J. P. MacSweeney.
"The Canning Industry," by Mr. W. A. Ehlers.

LIGHTING CONTRACT HELD UP.—Although the Baston (Mass.) Council was ready to act upon the proposed contract for gas lighting on the streets with the Boston Consolidated Gas Company, the members decided after a brief discussion to ask the Corporation Council for a written opinion as to the legality of annexing to the original 10 year contract an agreement of the gas company to authorize the Mayor to terminate the contract at the expiration of the 5th year. The contract price of $21 a lamp per year was not changed. A communication from William B. Lawrence, attorney for the Public Service Lighting Corporation, urging the council to reject the present contract and allow his company to submit a lower bid was tabled in the executive committee.

ACCIDENTS DUE TO BAD LIGHTING.—This is without a doubt a commercial subject, since poor lighting in factories, schoolrooms, shops, etc., is responsible for much weakened eyesight, and in a recent report a New York Casualty Company placed inadequate lighting first among the causes of injuries to employees in factories and shops. Three things must be considered—the quantity of light, the placing of lamps so that there will be no glare, and precaution against shadows. One of the greatest defects is that lamps are not sufficiently shaded and are too frequently placed in positions from which they dazzle the eyes and put a strain on the nerves of vision. If the lamp is on the right hand side a shadow is cast, a very common fault in banks and offices where much writing is done. In mechanical operations, such as cutting and drilling, it is very important that the light come from the proper direction. Dangerous machinery should be especially well lighted. The French government has appointed a committee on the hygienic aspects of illumination, composed of physiologists, oculists, engineers, physicists and inspectors of factories. If such a thing were possible here, a committee of that sort, with all the statistics, could go before State legislatures and demand the passage of the necessary laws for protection.

(Continued from page 375.)



A, Generator. B, Gas washing bottle. C, Combustion vessel. D, Absorption bottle. E, Burette.

The process was designed in 1907, and has been exclusively adopted since, owing to its many advantages over any other. Some favorable features are as follows:

1. Rapidity. From the weighing of the sample to calculation of the result, should not occupy more than from 20 to 25 minutes, a part of which time the attention of the operator may be diverted to other work if desired.

2. Accuracy. Repeat test on the same pulverized sample can be relied upon to come within 0.5 per cent. of each other; thus proving always the complete combustion of the sulphur.

[The gravimetric and volumetric estimates will coincide within a decimal point or two of each other. A comparison with the carbon bisulphide process shows 0.3 to 1 per cent. higher yield of sulphur by combustion. This is to be expected, owing to the presence of combined sulphur; the amount varying with the condition of the charge.]

3. Simplicity. The manipulation of the test is sufficiently simple to be within the scope of the workman tester—that useful institution now to be found in both large and small works. It is quite independent of the personal elements for its accuracy. This is a useful feature, for however valuable the personal equation may sometimes be in re earch work, it is desirable to keep routine work as mechanical as possible within reason.

4. Practically any quality of oxide may be successfully tested—it may contain as little as 1 per cent. of sulphur, whether revivified or unrevivified, and as much as 20 per cent. of moisture. Thus the rapidity with which the condition of the oxide just discharged from a purifier may be known is very useful.

5. Not the least important advantage is the fact that the process is similar to that in burning oxide for sulphuric acid manufacture, in which case the total sulphur available for the purpose is indicated; and this is eminently desirable. Also the residual sulphur in the burnt oxide may be estimated.

Minor advantages—such as the absence of the odor of carbon bisulphide and its inflammability—are of some value in the laboratory and to the staff.

As regards the cost, there are only the standard solutions and the oxygen to be considered. The oxygen may be conveniently supplied from a cylinder. For cases where these are not easily obtainable, however, the author has designed a simple automatic generator for use with sodium peroxide or similar reagent for generating oxygen by contact with water. This generator is fool-proof and perfectly safe in use.

The apparatus required for the complete test is shown in the accompanying illustration. The burette shown is scaled to give the percentage of sulphur in the oxide direct at the end of titration; so that no calculation is required. Just one precaution is necessary in carrying out the test. The manufacturers of hydrogen peroxide add a little phosphoric acid to it to incaease the stability: so that it is generally sent out in a very slightly acid condition. Therefore, the small volume used for oxidizing a portion of the test solution has to be previously rendered neutral with sodium hydrate.

THE Detroit City Gas Company is assisting the city authorities to find lodging for the veterans of the G. A. R., who meet there in August, by having its meter readers make appeals to gas consumers for aid in taking care of the many thousand visitors expected.

Partial and Intermittent Combustion of Gas.[1]

By E. E. SOMERMEIER.

A *combustible mixture* is usually defined as a mixture of a composition such that if any part of it is raised to its ignition temperature a reaction between the components will become self-sustaining and will extend to all parts of the mixture; an *inflammable mixture* as a mixture of a composition such that if ignited at any point a visible flame will spread throughout the entire mixture; an *explosive mixture* as a mixture of a composition such that if a portion of it is raised to its ignition temperature, an explosive reaction will take place throughout the entire mass. Given a sufficiently large volume of gas, any mixture which is combustible or inflammable is also explosive.

With the combustion once started, one of three things is possible: The reaction may decrease in rapidity; it may remain constant; or may increase in rapidity. An exactly constant rate of reaction is so rare that it may be disregarded as a possibility, and the reaction may be expected either to accelerate or to decrease in velocity. If it accelerates, an explosion will occur, provided a sufficiently large volume of gas is present. If it decreases, the combustion will die out and the gas, practically speaking, will be incombustible or at least only partially combustible.

The data regarding the lower limits of combustible and explosive mixtures of gas with air or with oxygen differ greatly. As an illustration, Hempel gives the lower limit of combustible mixtures of hydrogen with air as from 5 to 6 per cent., most other authorities giving from 9 to 10 per cent. Techlu gives the lower limits of an explosive mixture of methane with air as 3.2 per cent.; Burrell gives 5.5 per cent., and most other authorities about 6.0 per cent. In comparing such widely different values one is at a loss as to the real facts. That differences of such magnitude are due to errors of manipulation by some of the experimenters is hardly probable, and they are rather to be ascribed to differences in conditions and in methods of work. Some of the probable factors contributing to these differences in experimental results are: (1) Impurities in the gases with which the experiments were performed. (2) Differences in the initial temperature of the gas, (3) Differences in the initial pressure of the gas. (4) Differences in the volumes of gas used. (5) Differences in method of ignition. (6) Differences in the design or style of the containers.

The recorded results, unless otherwise noted, were presumably obtained by starting at ordinary laboratory temperature and at atmospheric pressure, and it is hardly possible that any large amounts of unknown impurities were present in the gas mixtures used. It would therefore appear that no great discrepancies in results are to be explained by the first three sources of error, and large variations are more likely, due to the latter three. By varying these conditions the writer, as will be shown later in this paper, obtained results, which, while they are not entirely concordant, do tend to suggest reasons for the different values given.

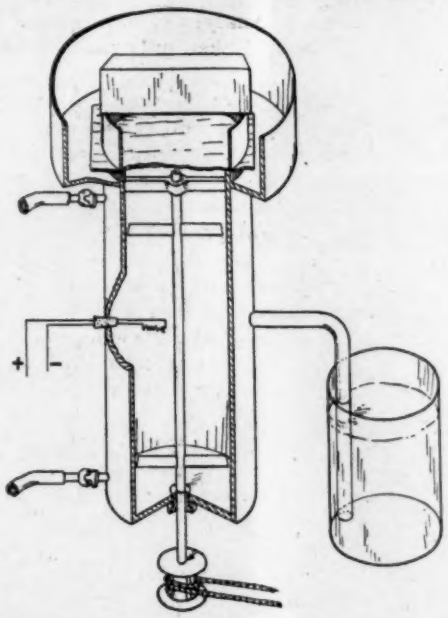
In the experiments here described the following volumes of gas mixtures were used:

Container. No	Dimensions—Diam., Cm.	Dimensions—Length, Cm.	Kind.	Vol. cc.	Condition of Experiment.
1.....	..	..	Glass flasks.	145	Gas confined.
2.....	8	26	Iron cylinder.	1,300	"
3.....	9.5	29	Glass "	2,100	Open at end.
4.....	20	38	Iron "	13,000	Gas confined.
5.....	30	42	" "	30,000	"

For the smallest container an ordinary short-neck globular CO^2 flask was used, which, when stoppered, had a capacity of 145 cc.

Each of the iron cylinders had an opening for the attachment of a water-sealed glass tube, with an opening for the insertion of a stopper carrying copper lead wires to which the wire fuses were attached, and with two pet cocks through which gas could be admitted or withdrawn and also through which water could be admitted to replace the gas withdrawn in sampling. The accompanying cut of the 13,000 cc. cylinder shows the general arrangement of the stirring apparatus, glass delivery tube, paraffined paper-top, etc. The projecting flange at the top is of galvanized iron and was used when it was desired to secure a water seal around paraffined paper. In experiments with mixtures rich enough to produce much of a reaction several thicknesses of paraffined paper were used and the necessary

1. "Journal of Industrial and Engineering Chemistry."



weight to hold the paper in place secured by using the ring above the paper as the fulcrum of a lever 5 or 6 feet long, upon the end of which weights were placed. In this way pressures equivalent to 700 or 800 pounds upon the head of the cylinder were readily secured.

The following methods of ignition were used:

1..0.5 to 0.75 cm. No. 34 platinum wire, heated to white heat.
2..0.5 and 5 cm. No. 34 platinum wire, fused.
3..0.5 and 5 cm. No. 34 iron wire, fused.
4..5 cm. No. 34 tantalum wire, fused.
5..0.25 cm. spark from induction coil.
6..Oxygen-natural gas flame.

In performing the experiments with closed containers, two methods of observing whether or not a reaction took place were used.

(1) A bent glass tube was attached to the container, the open end of which dipped into water. With a vigorous reaction, gas was forced through the tube and bubbled up through the water. With a less vigorous reaction, the water in the tube was depressed through a noticeable distance.

Diameters of Delivery Tubes Used.

145 cc. flask.	3 mm. tube.	13,000 cc. cylinder.	12 mm. tube.
1,300 cc. cylinder.	6 mm. tube.	30,000 cc. cylinder.	12 mm. tube.

(2) The mouth of the container was closed with paraffined paper, which, being flexible, was visibly moved by a slight reaction in the gas mixture, while with a vigorous explosion or combustion it was ruptured. This method was employed in some of the experiments with the cylinders of capacities of 1,300 cc. and 13,000 cc.

In the experiments in which a delivery tube was used, any gas which escaped was replaced by water, and the analysis of the residual gas did not need to be corrected for dilution with air. The composition of the residual gas from experiments in which the cylinders were closed with paraffined paper was usually somewhat affected by dilution with air. There was more or less leakage of gas outward around the edge of the cylinder when the gas was subject to the pressure caused by combustion or explosion, and this was followed by a resultant leakage of air inward upon the cooling and contraction of the gas. The errors in the results caused by this leakage were, however, of minor importance and had no bearing on the general conclusions deduced from the analysis.

In using the 145 cc. flask no effort was made to mix the gas and air, as with this small volume diffusion was deemed sufficient to give a uniform mixture after a few minutes. In using cylinders containing 1,300 cc., 2,000 cc., and 30,000 cc., mixing was secured by inverting the cylinder 10 or 12 times and allowing it to stand each time for a few seconds up to several minutes before reversing. In using a cylinder of 13,000 cc., mixing was accomplished by means of a pair of fan blades on a rotating shaft which was turned several hundred times before the ignition of the mixture.

The current used for heating the 0.5 to 0.75 cm. No. 34 platinum wire to a white heat was obtained by using two 32 candle power carbon lamps in parallel. For fusing the platinum, iron and tantalum wire, three to four 32-candle power lamps in parallel were used. In the fusing of the platinum wire less than one calorie of heat was developed. In the fusion of the iron and tantalum wires slightly more heat may have been developed owing to some oxidation. In the experiments with the 13,000 cc. cylinder one calorie of heat would be sufficient to raise the temperature of the gas mixture only about 3° C.

All the experiments were performed at laboratory temperatures which varied for different days from 18° C. to 27° C. Some of the results obtained with the different methods of ignition and the different volumes of gas together with analyses of the resultant gases are as follows:

Hydrogen and Air.—With the 145 cc. flask.—Method of ignition, 0.5 cm. No. 34 platinum wire heated to white heat for 2 seconds. A blank on air under the same conditions gave a 5 cm. depression of water in the delivery tube.

Results with Different Percentages of Hydrogen in Air.

Per Cent. Hydrogen.	Depression. Cm.	Per Cent. Hydrogen.	Depression. Cm.
4.5	10	6.0	20
5.0	14	7.1	70
5.5	20	8.2	Flask blown off of the stopper.

Turning on the current for two additional intervals of one second each gave further reactions as follows:

Per Cent. Hydrogen.	Depressions, Cm.	Per Cent. Hydrogen.	Depressions, Cm.
5.0	15 and 10	6.0	20 and 12
5.5	20 and 10	7.1	20 and 15

After the third ignition of the 5.5 per cent. mixture, analysis of residual gas for oxygen showed that only 0.2 per cent. of the oxygen had burned, equivalent to 0.4 per cent. of hydrogen.

Results with a 0.25 Cm. Spark for 0.5 Sec. from an Induction Coil.

Per Cent. Hydrogen.	Depression. Cm.	Per Cent. Hydrogen.	Depression. Cm.
4.3		5.6	
1st spark	20	1st spark	25
2d spark	20	2d spark	25
3d spark	5	7.0	
		1st spark	75
		2d spark	50

With the 1,300 cc. Cylinder.—Method of ignition, fusion of 0.75 cm. of No. 34 iron wire, Extent of reaction noted by movement of paraffined paper on the head of the cylinder.

Per Cent. Hydrogen.	Result.	Per Cent. Hydrogen.	Result.
4.5	No visible reaction.	7	Very fair reaction.
4.6	Very faint reaction.	8	Weak explosion.
5.0	Fair reaction.	9	Fair explosion, not violent.
6.0	Fair reaction.	10	Vigorous explosion.

With the cylinder water-sealed, glass tube to allow the escape of gas, and an iron wire fuse, several experiments with 7.7 per cent. hydrogen all gave vigorous reactions, gas being forced out through the water seal. Analysis of the residual gas for oxygen showed that from 1.4 to 2 per cent. of hydrogen had burned.

With the 13,000 cc. cylinder, iron wire fuse and 6 per cent. hydrogen, about 500 cc. of the gas were forced out through 20 cm of water. An analysis of the residual gas for oxygen showed that about 0.5 per cent. of hydrogen had burned. With 7.7 per cent. hydrogen about 2 liters of gas were forced out of the cylinder. An analysis of the residual gas showed that 0.4 per cent. hydrogen burned. Ignition of the residual gas by means of additional fuses gave combustion reactions up to 10 fuses. Up to the fourth fuse the reaction produced forced gas out of the cylinder through 30 cm. of water. Using 0.5 cm. of No. 34 platinum wire heated to a white heat for 2 seconds, a 7.7 per cent. mixture of hydrogen gave two distinct reactions, the gas escaping through 20 cm. of water in two closely succeeding but distinctly separate portions. Analysis of the residual gas showed that 1.6 per cent. of hydrogen had burned. Using a spark from the induction coil for about 0.1 second, a 7.7 per cent. mixture of hydrogen gave a very vigorous reaction, several liters of gas being forced out of the cylinders. Analysis of the residual gas indicated that 0.8 per cent. of hydrogen had burned. With 7.6 per cent. hydrogen and with the spark left running for several seconds, three distinct reactions were observed.

With the 30,000 cc. cylinder and iron wire fuse, mixtures of from 7.3 to 7.7 per cent. hydrogen gave fair reactions, indicated by the forcing of gas out of the cylinder through water. Analysis of the residual gas showed that only about 0.4 per cent. of hydrogen had

burned. A 7.7 per cent. mixture ignited with a dozen successive fuses gave reaction each time; up to the ninth fuse, the reaction forced gas out of the cylinder through 18 cm. of water; whereas, the burning of a fuse in the cylinder filled with air gave no visible depression.

Natural Gas and Air.—Natural gas from the Columbus, O., city mains was used, consisting of approximately 85 per cent. of methane and 15 per cent. of ethane.

With the 145 cc. flask, a 5 per cent. mixture of natural gas and air gave no visible reaction when ignited with 0.75 cm. of No. 34 platinum wire heated to a white heat.

Per Cent. Natural Gas in Air.	Spark.	Time of Spark Seconds.	Depression Cm.	Per Cent. Natural Gas in Air.	Spark.	Time of Spark Seconds.	Depression Cm.
4.4	1st	1	30	5.6	1st	½	75
	2nd	1	20		2nd	2	60
	3rd	1	20		3rd	2	50
5.0	1st	1	30		4th	4	75
	2nd	1	25	Blank on air	1st	1	10
					2nd	5	20

On several other tests with mixtures of from 5.7 per cent. to 5.2 per cent. of gas and using a spark for 0.5 second, the flask was blown from the stopper.

With the 1,300 cc. Cylinder.—Method of ignition, fusion of from 0.5 to 0.75 cm. No. 34 platinum or iron wire. A 4.6 per cent. mixture of gas and air produced a 4 cm. depression. A blank on air produced a depression of 1 cm.

A mixture of 4.8 per cent. of gas and air produced vigorous reactions, gas being forced out against a pressure of 5 pounds per square inch. Analysis showed the presence of 2.6 per cent. CO_2, indicating that about one half of the gas had been burned. With paraffined paper closing one end of the cylinder, and with a 0.75 cm. platinum wire heated to fusion, a fair reaction was detected with as low as 4.6 to 4.7 per cent. mixtures of natural gas and air. Mixtures of from 4.9 to 5 per cent. of gas and air gave fair combustion, a distinct flame being visible.

Results with 5 cm. No. 34 Iron and Platinum Fuses.—Blanks on fuses in air gave for the iron fuse a depression of 12 cm. and for the platinum fuse a depression of 10 cm. A 4.3 per cent. mixture of gas and air gave a depression of 30 cm. with an iron fuse and a depression of 20 cm. with a platinum fuse. Using a 5 cm. tantalum wire fuse, blanks on fuse in air gave a depression of 12 cm. Mixtures of 4.3 per cent. and 4.4 per cent. of gas and air gave depressions of 40 and 50 cm., respectively.

With the 13,000 cc. cylinder, iron wire fuse, paraffined paper head on cylinder.

With a 4.7 per cent. mixture of natural gas, no visible reaction was produced.

With a 4.8 per cent. mixture of natural gas, a faint reaction was produced.

With a 5 per cent. mixture of natural gas, a fair reaction was produced.

With a 5.2 to 5.3 per cent. mixture of natural gas, a fair reaction was produced, the paper head of the cylinder being scorched by the heat of the combustion.

Tests after combustion on the residual gas from mixtures containing 5.2 and 5.3 per cent. of natural gas gave results for CO_2 of from 0.8 to 1.2 per cent., indicating that approximately this amount of the natural gas had burned. These values are, however, somewhat too low, owing to the leaks inward of air after combustion. This is shown by the more complete analysis after combustion of the residual gas from a 5 per cent. mixture of natural gas, upon which values were obtained as follows: CO_2 1.4, CH_4 2.7, C_2H_6 0.6 per cent.

On the basis of natural gas consisting of approximately 85 per cent. CH_4 and 15 per cent C_2H_6 the original mixture contained 4.25 per cent. of CH_4 and 0.75 per cent. of C_2H_6. On the residual gas after combustion the C_2H_6 is 0.15 per cent. lower and the CH_4 1.55 per cent. lower than in the original mixture. If these amounts burned to CO_2 the CO_2 formed would equal $1.55 + 0.30 = 1.85$ per cent. as against 1.4 per cent. of CO_2 actually found. This corresponds to a dilution of the original mixture with approximately 25 per cent. of air.

Effect on ignition by a white hot platinum wire compared with ignition by fusion of the wire.—A 5.1 per cent. mixture, with 0.75 cm. No. 34 platinum wire, heated to a white heat for 2 seconds, gave no visible reaction, but upon turning on additional current and fusing the wire, a fair reaction occurred, about 500 cc. of gas being forced out of the cylinder. Analysis of the residual gas for carbon dioxide and oxygen indicated that only about 0.2 per cent. of the natural gas had burned.

The ignition of the gas by fusion of the wire and its failure to ignite from the wire raised to white heat shows very clearly the great effect of a very high temperature of ignition upon the starting of the reaction.

Experiments with the Oxygen-Natural Gas Flame as a Source of Ignition.—Mixtures of natural gas and air, and hydrogen and air were collected over water in the 2,100 cc. glass cylinder which was then closed with a glass plate. The gases were mixed by inverting the cylinder a number of times, and then with the cylinder inverted, it was quickly slipped off of the glass plate which closed it and passed over the oxygen gas flame, the flame being in the cylinder for about ½ second. This flame was about 10 cm. long and consumed about 3 cc. of gas per second.

No visible combustion was obtained with 5 per cent. of gas, but with 5.5 per cent. mixture the combustion was quite evident, a blue flame spreading slowly throughout the cylinder. With hydrogen no reaction was detected with a 6 per cent. mixture. With a 7 per cent. and a 7.7 per cent. mixture no visible flame was noticeable, but an appreciable reaction was indicated by the deposit of a film of moisture upon the cold sides of the cylinder. That an appreciable reaction is started by the oxygen-natural gas flame in mixtures of natural gas and air lower than 5.5 per cent., is shown by the following experiments upon different mixtures of gas and air in the 13,000 cc. cylinder. In making the experiments a cork was removed from a 2 cm. opening in the side of the cylinder and the tip of a flame inserted into the cylinder for from 1 to 3 seconds. Considerable reaction occurred, as was shown by the rapid swelling of the paraffined paper top used to close the cylinder and by the rapid escape of gas through the opening through which the flame was inserted. In each case the effect was greater than that which was produced in blank tests upon the cylinder filled with air. The extent of the reaction was approximately determined by analysis of the residual mixtures for CO_2. The flame used 3 cc. of natural gas, and produced approximately 3 cc. of CO_2 per second; or in the 13,000 cc. mixture less than 0.03 per cent. of CO_2 per second was added from this source. The results obtained upon the residual mixtures were as follows:

Per Cent of Natural Gas in Mixture.	Time of Flame in Cylinder Seconds.	Per Cent. CO_2 in Resultant Mixture.	CO_2 from Flame.	Per Cent of CO_2 from Gas Burned.	Approximate cc. of Natural Gas Burned.
4.4	5	1.0	0.15	0.85	100
4.0	5	1.0	0.15	0.85	100
3.2	3	0.6	0.10	0.50	60
2.0	4	0.3	0.10	0.20	25

These results all show appreciable combustion around the flame. This combustion was in all cases greater than is shown by these results on account of the expansion of the gas and the dilution of the remaining gas with air upon contraction before the gas was sampled and analyzed. That partial combustion of such mixtures occurs is shown by the well known lengthening of a lamp flame in air containing fire damp.

Analysis of Results.—These experiments show conclusively that with a high initial ignition temperature a reaction may start in a gas mixture, which, as a whole, may be incombustible because the heat of combustion is not sufficent to maintain the temperature at the kindling point. Hence all of the mixture will not burn, although the reaction may be sufficently extensive as to make the mixture appear to be combustible or explosive. With the source of high temperature employed to cause ignition acting only a very short time, as during the fusion of platinum or iron wire, the resultant reaction quickly ceases, but not until a combustion of gas has occurred, the heat of which is in some cases equivalent to hundreds of times the energy required to heat the platinum or iron fuse. The heat liberated by the fusion of 0.75 cm. of No. 34 platinum or iron wire is only a fraction of a calorie. In a 7.7 per cent. mixture of hydrogen this fuse causes a combustion of 0.4 per cent. of hydrogen in a 30,000 cc. mixture or of 120 cc. of hydrogen. This liberates about 300 calories of heat. In the smaller containers a greater percentage of hydrogen was burned. For example, in the 1,300 cc. cylinder as high as 2 per cent. of hydrogen burned, or only 26 cc. From this it would appear that when the combustion is started from a source of very high temperature, more gas is burned in a large volume of mixture than in a small volume, but that the greater percentage of the gas is burned in the smaller mixture. This is at least partially accounted for by the cooling of the gas by the walls of the container, especially where

small volumes are burned; but with large volumes of gas, as in the case of two large cylinders, holding 13,000 and 30,000 cc. respectively, this would be of little effect, and in a room full of gas the effect would be entirely negligible. With a continuous source of high temperature, as with a white hot wire, a lamp flame or a running electric spark, the action produced may be intermittent. The gas immediately around the point of ignition burns and expands, and combustion around that point ceases until another portion of the mixture of gas and air has replaced the expanded gas and products of combustion, whereupon another reaction takes place, resulting in a series of combustions or explosions.

The limits of appreciable ignition or combustion of hydrogen and of natural gas in air vary with the volume of gas used, the source of ignition and the style of the container. In a 2,000 cc. open cylinder the lower limit obtained for natural gas is about 5.5 per cent. With hydrogen the lower limit for very appreciable ignition was above 7 per cent. In a closed container the lower limit for natural gas using 0.5 cm. of No. 34 platinum wire heated white hot, was over 5 per cent. With a 0.5 cm. platinum or iron wire fused the lower limit obtained was 4.7 to 4.8 per cent. With a 5 cm. No. 34 wire fused the lower limit obtained was about 4.3 per cent. With a 5 cm. No. 36 tantalum wire fused the lower limit was about 4.3 per cent. With a 0.25 cm. spark from an induction coil the lower limit of appreciable reaction was about 4.3 per cent. With closed containers, 6 to 7 per cent. mixtures of hydrogen and air gave vigorous reactions with 0.5 cm. platinum or iron wire fuses. With the electric spark, mixtures as low as 5 per cent. gave very noticeable reactions, and faint reactions were obtained with mixtures as low as 4.3 to 4.6 per cent.

For the same percentage of gas and the same method of ignition, small volumes of gas gave more vigorous reactions than large volumes, but in total amount of gas burned, the combustion obtained in large volumes was greater than that obtained in small volumes.

With smaller containers, or with a more powerful spark, or a longer wire fuse, undoubtedly very appreciable reactions can be obtained with mixtures of lower percentages than those given, but with ordinary sources of ignition, large volumes of gas will not react appreciably unless the mixture is richer in gas than the lowest limits obtained in these experiments. However, the thermal calculations based on 850° and 700° as the ignition temperature required for explosive mixtures of natural gas and of hydrogen with air indicate that mixtures of natural gas in excess of 2 per cent. and of hydrogen in excess of 5.9 per cent. are potentially explosive if condition favorable to the reaction are present. Some of these conditions, in addition to a vigorous source of ignition, are unusually high initial temperature of the mixtures of gas and air,, presence of fine combustible dust, and an increase in the pressure of the mixture.

The results of these experiments indicate that a comparatively small excess of hydrogen above the theoretical requirement is necessary to produce a vigorous reaction. Natural gas or methane, on the other hand, ignites with such difficulty that, with ordinary methods of ignition, an appreciable reaction does not occur unless a very large excess of gas is present above that required by the thermal calculation.

New Methods and Appliances.

METHODS OF WELDING.—Before the Institution of Mechanical Engineers, London, T. T. Heaton spoke of welding by the oxy-acetylene and electric pracesses. The Benardos electric system uses direct current at 90 volts, the quantity of current ranging from 200 to 500 amperes, depending on the thickness of the pieces welded. The work forms the positive pole and a rod of carbon the negative pole. By this arrangement the greatest heat is in the weld.

The Zerener process uses two carbons in the same holder, with a magnet between to deflect the arc down on the work, no current passing through the work.

The Strohmenger-Slaughter system uses either direct or alternating current, the latter preferred. The voltage ranges between 85 and 220, and the quantity of current used depends on the work. The parts to be welded are placed in juxtaposition, and an electrode is laid along the welding line. Contact is made between the work and one end of the electrode, which fuses by a series of arcs along the welding line, melting the electrode into the work and coating the weld with a vitreous flux, which it is claimed prevents oxidization.

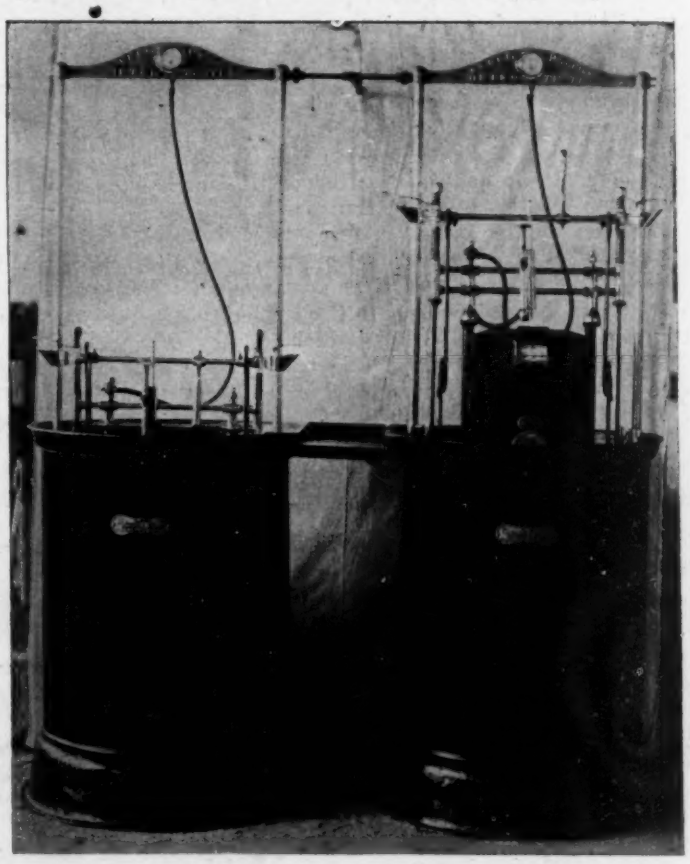
Electric contact welding is performed by machinery. In the Thomson-Houston process the pieces to be welded are fixed in a machine, one immovable and the other in a slide rest. The piece in the movable slide is pressed against the other, while a heavy alternating current is passed through. The resistance of the joint causes a rise of temperature, and the movable piece is pressed forward until a complete union is made. A little hammering is sometimes applied to finish the joint. The voltage is only from 2 to 4 volts, and the current density ranges from 16,000 to 20,000 amperes per square inch.

In spot welding the work is laid upon a fixed copper contact-piece or electrode. When in position a second movable electrode is placed upon it immediately above the fixed electrode. The current, in passing from one electrode to the other, heats and welds the work. In roller welding the electrodes are rollers which grip the overlapped work between them, heating and welding it as it travels. This system requires good quality metal, homogeous and free from dirt.

In gas welding heat is produced by a mixture of gas with oxygen. The best gas probably is acetylene, but other gases are used in conjunction with oxygen, viz., benzol vapor, coal gas and hydrogen. Owing to the lower temperature the oxy-acetylene flame is better for thin work than the electric arc, because the risk of burning the metal is not so great. The temperature of the electric arc is about 7,500° F., and the oxy-acetylene flame about 6,000° F. Where work is suitable for the electric arc, welds can be made by it far more quickly than by the oxy-acetylene flame. The proportions of the two gases in welding vary somewhat, but should be in the neighborhood of 1.5 volumes of oxygen to 1 volume of acetylene.

Naturally the character of the metal in the weld is changed to some extent. It loses some of its ductility and some of its strength, but less than a blacksmith's weld. Tests show that 89 to 96 per cent. of the original strength of the metal can be relied on in the electric weld.

HYDRO PNEUMATIC METER TESTER.—This is an apparatus by which a meter can be easily and quickly tested for leaks in case it leaks into gallery. The cut shows two machines, one with a meter submerged and under test, and the other on the carriage, ready.



It consists of a tank having an open top and adapted to contain a supply of water, a meter carrier, a cross head with fittings for connection with a meter and communicating with a source of fluid pressure supply, and other accessories which greatly facilitate meter testing. One man tests 600 meters in 8 hours; and one company using it states that 23 per cent. of the meters which they had previously tested and thought tight, showed leaks when tested on the Hydro Pneumatic Meter Tester.

In using the apparatus, the meter to be tested is placed on the plat-

form, the fittings of the cross head secured to the meter, and the carrier moved down until the meter is submerged. Where the bubbles rise indicates the location of the leak. Only one movement of the lever is necessary to connect the meter and the return movement of the lever releases it, eliminating the waste of time in most other meter-testing operations. The tester is made under patents granted to Messrs. F. C. Shephard and J. T. Lucas, of Minneapolis, Minn.

COATING IRON WITH ALUMINUM.—A process invented by S. Uyeno, or Tokyo, coats iron with aluminum by dipping it in a bath of the molten metal after it has first been galvanized. The aluminum bath is 600° to 800° C., and the temporary zinc surface comes away in the first dipping, but to get the best results the article to be coated is treated 2 or 3 times. The surface of the article is brushed with a steel brush during immersion. It is claimed that the aluminum coating has extraordinary good adhesion, so that it will not peel off, and even cannot be stripped off by mechanical means.

Book Reviews.

"*The Elementary Principles of Illumination and Artificial Lighting*," by Arthur Blok, B. Sc. Published by Scott, Greenwood & Son., London, England.

This work comprising 248 pages with 126 illustrations, while English in origin, is world-wide in scope; and while reference is made of the various units of intensity used by the different countries, the international candle is accepted as the standard unit. Many references are made and quotations given from American engineers and physicists, among whom are Dr. Louis Bell, Dr. E. P. Hyde, Dr. H. E. Ives, Dr. A. E. Kenelly; Messrs. Van R. Lansingh, Norman Macbeth, P. S. Millar, Dr. S. H. Sharp and D. M. Moore. As the title states, the author has made the book elementary. The symbols used in the formula are given at the beginning of the book, as are also the formula used so that the student may study and familiarize himself with these before he begins the study of the subjects of the various chapters.

The subjects treated by chapters are: The Nature of Light; Units and Standards; The Laws of Illumination; The Methods and Apparatus used in Illumination Measurement; Illumination Calculations; The Derivation of Polar Curves; The Ulrecht Integating Sphere; Reflectors, Globes and Shades; Indoor Illumination; Outdoor Illumination; The Properties of Illuminants.

Numerous tables are given throughout the book, and while the entire subject is treated in an elementary way, the work is compre hensive, and full credit is given to gas as an illuminant, and the work is not devoted entirely to electric lighting, as are most books treating on the subject of illumination.

The book is one, that with a little study of the symbols and formula, any layman ought to be able to master; and it should be in the hands of everyone connected with a lighting company, that in any way comes in contact with lighting problems, as much useful information has been gathered by the author.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent cases, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,096,797. Gas Process and Product. W. O. Snelling, Pittsburgh, Pa., assignor to Consolidated Liquid Gas Co., Chicago, Ills.
1,096,836. Safety Automatic Valve for Gas Burners. E S. Halsey, Lynn, Mass., assignor to American Gas Light Co., Boston, Mass.
1,097,085-86. Gas and Air Burning Burner. J. W. Fennel, Newburgh, N. Y.
1,097,092. Inverted Mantle Burner. G. T. Hadley, San Francisco, Cal.
1,097,141. Gas Producer. H. Poetter, Dusseldorf, Germany.
1,097,236. Gas Pressure Regulating Device. J. J. Kerr, Cleveland, O., assignor to Semet-Solvay Co., N. Y.
1,097,322. Gas Regulator. A. J. Hodge, Pasadena, Cal.
1,097,432. Gas Valve. I. F. Hepler, Narberth, Pa., assignor to J. S. & W. P. Worth, Coatesville, Pa.
1,097,441. Gas Cock Operating Device. B. Jenkins, Washington, D. C.
1,097,482. Automatic Gas Cut Off. S. Tagliamonte, Somerville, Mass.
1,097,513. Manufacture of Gas. H. W. Benner, Bethlehem, Pa., assignor to International Gas Development Co., New York city.
1,097,719. Gas Lamp. A. H. Humphrey, New York city.
1,097,715. Gas Producer. J. F. Guggolz, Teague, Tex.

Items of Interest
FROM VARIOUS LOCALITIES.

BY a unanimous vote of the City Council of Auburn (Wash.) J. L. Veach, representing a company seeking a franchise to use Auburn streets for the laying of gas mains, has been given a 50-years' franchise. The maximum price that can be charged by the company will be $1.40 per 1,000 cubic feet and, in the event the city becomes one of the second class, the rate will be lowered to $1.25 per 1,000. Should the city ever become one of the first class a maximum price will be $1.00 per 1,000 feet.

THE plant of the Sussex Gas Company, of Lewes, Del., is about to be extensively improved. It has been inspected by Messrs. H. M. Tracey, of Philadelphia; S. Bell, of Haddonville, N. J., and James Logan, of Phœnixville, Pa., who will make recommendations as to the changes advisable.

THE Williamstown (Pa.) Gas Company was recently granted permission by the County Commissioners to cross the Wiconisco creek bridge, between Wiconisco and Lykens, with a gas main. An agreement was entered into by the county and the gas company under which the latter will pay an annual rental of $10 in advance.

THE Dover, Rockaway and Port Oram (N. J.) Gas Company has notified the Dover authorities that it has filed an application with the Board of Public Utility Commissioners for a modification of its local franchise. The Company seeks a reduction of the franchise tax from 5 to 2 per cent., and asks exemption from the franchise tax now collected for gas piped through Dover to other municipalities. The Company also asks that a single price of gas per 1,000 feet prevail regardless of production. Under the present arrangement the price is reduced from $1.25 to $1 when 25,000,000 cubic feet per year has been produced. The Company further petitions to be permitted to fix a minimum charge of $1 a month, and an optional rate, based on a flat charge plus gas at 80 cents per 1,000 cubic feet.

THE Eastern section of the borough of Norwood, Pa., was thrown into a state of complete darkness a few weeks ago. Considerable difficulty was encountered in the homes owing to the want of a means for lighting them and providing facilities for preparing the evening meal. The section remained in darkness all through the night and lamps and candles were at a premium. The trouble was caused by a stoppage in the gas main, and it was not until 5 next morning that the gas was again turned on and the people notified as a precaution.

THE State Tax Commission, of Wisconsin, was scheduled to meet in Milwaukee on Friday, May 29, to discuss with assessors the valuation to be placed this year on the property of the Milwaukee Gas Light Company for taxation purposes. Conferences will also be held with the assessors of the towns of Milwaukee, Greenfield, Lake, Wauwatosa and East Milwavkee on this subject. North Milwaukee is not included in the commission's mission, because the company has disposed of its plant in that territory and the gas making and distribution there is conducted by a separate corporation. Expectations are that there will be a deduction allowed of about $100,446 because of the North Milwaukee plant having been disposed of.

ELLICOTT CITY, Md., will have gas this summer for the first time in the history of that quaint old town, if the plans of the Consolidated Gas, Electric Light and Power Company are carried out. The Company expects to extend its 12-inch main from Catonsville to Ellicott City, a distance of 3 miles, and hopes to have the work completed by late summer.

WE are told that rapid progress is being made on the big gas plant Alabama capitalists are erecting in Waycross, Ga., and from present prospects gas will be furnished by the plant early in the fall. Most of the brick work on the main building has been completed and quantities of piping and other material are arriving daily.

THE Georgetown, D. C., Gas Light Company has elected the following officers for the ensuing year: Robert D. Weaver, President; George L. Nicholson, Vice-President; H. H. Flather, Vice-President; Charles P. Williams, Secretary. The stockholders elected the following Directors: H. H. Flather, R. H. Goldsborough, W. A. Leitch, G. L. Nicholson, Robert D. Weaver, M. E. Weaver and Charles P. Williams. The annual report of the Company for the year ended May 31, 1913, places the value of the plant, equipment, works and property of the Company at $1,616,068.31; paid-up capital stock, $150,000; amount of gas manufactured, 191,039,600 cubic feet; amount sold, 152,056,360 cubic feet; gross earnings from the sale of gas and by-products, $99,169; net profits from the sale of gas and by-products, $43,817.

COMMISSIONER MERRITT, of Duluth, Minn., proposes to provide for main extensions of the municipal gas and water departments by assessing the cost thereof against the properties benefited. Assessments for the service in all cases will be made against the property according to the frontage abutting upon the street, regardless of whether the property is improved or unimproved. According to the ordinance proposed when the Council shall order an extension upon petition, "an easement shall be made against the property specially benefited by such extension or portion thereof so completed—which assessment shall be payable annually for a period not exceeding 15 years, and for each year shall be 8 per cent. of the total cost of the extension * * *." In determining the cost of any extension, it provides that any charge arising from the laying of mains larger than 6 inch mains for water and 4 inch for gas, shall not be more than the cost of either 6 or 4-inch mains respectively. Another clause stipulates that, after the completion of an extension, credit shall be given upon the assessment against the property so served, amounting to one half of the total receipts for water and one-third of the total receipts for gas each year.

MUNICIPAL ownership of gas in Battle Creek, Mich., is apparently a long way off, though at the last election the people voted for municipal ownership 4 to 1. At a late Commission meeting Commissioner Kneeland offered a resolution providing for the hiring of an expert to make an estimate of the cost of a municipal plant, and to fix a value on the plant of the Battle Creek Gas Company. Objection was made that a gas expert might cost the city as much as $100 per day, and the City Clerk will look up the question of salaries paid to gas experts. It is said that in case the Commission does not move rapidly enough on the gas question, the socialists will start petitions asking for a recall of the Mayor and entire city commission. Rather an unpleasant situation for the authorities.

THE gas plant of the Trenton (Mo.) Gas and Electric Company has been improved by the installation of a new blower equipment for the gas machine, a new drainage system for the purifiers, relining and remodeling of the gas generators, and the installation of a new station meter. They have also installed considerable in the way of new mains.

THE proposed new plant in Keokuk, Ia., will not be started this year. It was planned to spend some $100,000 for a new plant on Fifth street, but owing to financial stringency the Stone and Webster officials have decided to make the old plant do for at least another year.

So that the city will know how to deal intelligently with the question when it comes up, Mayor A. B. Connable, of Kalamazoo, Mich., urged the aldermen to seek information on the cost of gas production. The franchise of the gas company soon expires and the Mayor believes it would be well for the council to know something about the subject as soon as possible. He also wants an inquiry into the franchise of the Commonwealth Power Company to see whether that corporation has a right to manufacture and sell gas.

IN order that the city gas plant might increase its number of consumers the council of La Grange, Ga., has purchased from the different stores in town, all their gas stoves and ranges, and is now offering them to the public practically at cost. For some time before this deal was consummated there was considerable advocacy of this method, and this action of the city council meets with general approbation.

THE Hagerstown "Globe" announces that Mr. Marshall Milton, General Manager of the Hagerstown (Md.) Light and Heat Company is to go to Roanoke, Va, in charge of the company there; and that Mr. W. R. Rhodes, of Williamsport, Pa., will succeed Mr. Milton at Hagerstown.

MR. ALBERT ROST, who has been solicitor and salesman for the Winona (Minn.) Gas Light and Coke Company, for some time past, has been transferred to a similar position at Red Wing, with the Red Wing Gas Light and Power Company. Mr. Rost has rendered the Winona Company excellent service, and the transfer to Red Wing is in the line of promotion.

THE Pondre Valley Gas Company, of Fort Collins, Cal., is contemplating the erection of a new storage holder and other works' improvement.

ROCKY MOUNT, N. C., has decided to install a municipal gas plant, the first municipally owned gas plant to be erected in that State. Contract for the generating apparatus, etc., has been awarded to the Western Gas Construction Company, of Fort Wayne, Ind.

THE men of the Newport (R. I.) Gas Light Company have just finished replacing an old wooden pipe on Washington street, between Cherry and Batter streets, by an iron pipe. This wooden main had been in use more than 50 years, and was apparently in as good condition as when laid down. Another section of this wooden pipe, removed from the ground years ago to give way to cast iron pipe, is in use in the gas company's building for rain leader for water.

THE Richmond, Va., City Gas works is advertising for bids on its supply of gas oil for the next five years, specifying 2,000,000 gallons more or less per year, and a sulphur content of not more than ¼ of 1 per cent.

AT the Newark, N. J., Board of Trade weekly luncheon on Monday, W. J. Callanan, of the Central New York Gas and Electric Company, announced that the price of gas in Newark would be lowered from $1.45 a thousand cubic feet to 90 cents per thousand, with the usual meter rental of 50 cents per month. This is about a 25 per cent. reduction in all cases where the amount of gas used is over 1,000 feet a month. The new rate will become effective July 1st.

MR. H. W. BURBANK announces that he has removed his offices to the International Bank Building, Spring Street at Temple, Los Angeles, Cal., where he will continue his consulting engineering practice in matters relating to gas properties.

PRESIDENT H. M. Byllesby, Vice President A. S. Huey, and Vice-President and Treasurer J. J. O'Brien, of H. M. Byllesby & Company, are making a ten day tour of inspection of the Company's properties at Fort Smith, Ark., Oklahoma City, Muskogee, Enid, El Reno and Sapulpa, Oklahoma, for the purpose of determining the present and future needs from both an operating and construction standpoint.

THE Gas Machinery Company, of Cleveland, O., has received a good sized order for large valves from the Portland Gas and Coke Company of Portland, Oregon. They have also furnished many large sized valves to the Los Angeles Gas and Electric Corporation, Los Angeles, Cal., during the past year.

THE Town Council of Vader, Wash., has granted a 25 year franchise to the Vader Gas and Fuel Company to operate a plant in the town. In return for the franchise the Company agrees to furnish enough gas gratis to light the town hall and jail.

THE Springfield, Mass., "Recorder" says: "The motor truck responded to a still alarm recently from the Greenfield Gas Light Company's plant on Mill street. A fire on the roof was discovered by Arthur Fortin, one of the company's foremen, who promptly gave the alarm and then got busy and by the time help had arrived had the fire extinguished. It was a very fortunate occurrence that the fire was discovered as soon as it was, for if it had gotten a little more headway the whole plant might have been destroyed. As it was, but very little damage was done, thanks to the prompt work of Mr. Fortin.

Utilities Commission News.

REGULATED MONOPOLY.—The advantages of regulated monopoly vs. free competition as a regulative factor are thus summed up in the recommendation for the curtailment of the latter in the 41st Report of the Georgia Railroad Commission. "The attention of the Commission has, in a recent case, been called to the evils arising out of unrestrained and unreasoning competition between two local public utility companies occupying the same field, and to the burdens in the end, placed upon the public by reason of unnecessary and unwise investments and expenditures of capital, resulting from such conditions as invariably follow. Our public policy has been to encourage competition as a regulator of prices and a provider of good service, while at the same time we have pursued the opposite policy of governmental regulation. We do not believe competition can ever be a consistent and economical regulator of rates and other conditions, in a local public utility field. In such a field it means a duplication of investments, organization and operating expenses, which is unnecessary to the service, and burdensome upon the public. It is rarely maintained permanently."

FORM OF FRANCHISE CRITICISED.—In No. 1365 announcement was made by the California Commission that the application of the Oakdale Gas Company for a certificate permitting it to construct and operate a gas distributing system in the town of Riverbank and to construct a transmission main from its generator in Oakdale, will be granted when applicant has obtained a franchise meeting with the requirements of the Commission. The proposed franchise was criticised chiefly because it fixed rates, a power conferred on the Commission with respect to unincorporated territory, and because it allowed the applicant 3 years within which to complete the installation of the gas system, which seemed to the Commission to be longer than necessary.

EVANSVILLE, IND., HEARINGS.—The hearings before the Public Service Commission of Indiana in regard to the valuation of the gas plant of the Evansville Public Service Company have been started. The question which the Commission will decide is whether the valuation of the gas producting property of the Public Service Company as determined by the commission engineers recently and submitted to the city in a large report is a fair and accurate basis for the determination of gas rates. The city will contend that the valuation was too high, and the company will take the other side. After the commission has decided the proper valuation the rates will be based upon their decision.

PROTESTS AGAINST STOCK ISSUE.—The Cincinnati, O., Council recently unanimously adopted a motion directing the City Solicitor to protest to the State Public Utilities Commission against granting the application of the Union Gas and Electric Company to sell $375,000 worth of its preferred stock, the purpose of the proposed issue being to take up and cancel the outstanding script certificates issued one year ago in lieu of dividends to its stockholders. In view of the valuation now being made of the company's property by the city and the state, it was argued that the issuance of any new stock at the present time might prove harmful to the city's interests.

TO ADOPT HEATING VALUE STANDARD.—The Washington (D. C.) Public Utilities Commission have tentatively adopted regulations specifying a heating value standard of quality. They point out that the manufacture of gas, high in candle power, requires the use of considerable oil for enrichment, and a company manufacturing such a gas generally furnishes a mixture of water gas and coal gas, the water gas forming a large percentage of the mixture. On account of the high price of oil at present, gas high in candle power is relatively expensive to manufacture. Gas which is high in heating value can be made entirely of coal gas, with little or no oil enrichment. It therefore follows, the commission says, that under the new regulations considering the cost of manufacture alone, the gas light companies in the District should be able to manufacture gas at a less cost, and, therefore, should be able to furnish it to the consumers at a lower rate.

SECURED CAPITAL CHEAPER THAN OTHER CALIFORNIA UTILITIES.—A table of public utility bond issues authorized by the California Railroad Commission during its first 21 months jurisdiction over utilities shows that capital secured on the lowest terms by any of these issues was obtained by the San Diego Consolidated Gas & Electric Company, through the sale of $240,000 first mortgage 5 per cent. bonds at 95, which would yield the investor 5.34 per cent. This company has been under the management of H. H. Byllesby & Company for 7 years.

Financial Notes.

IN the pamphlet report of the Pacific Gas and Electric Company, President Frank G. Drum states the $10,000,000 bonds which the Company was authorized to issue to reimburse the treasury for new construction expense, will probably be canceled and a new form of security authorized instead. The stockholders will be notified shortly how this equity is to be capitalized. The general expectation is there will be a new issue of preferred stock. The income account for 1913 shows gross earnings of $15,869,006, an increase of $1,124,355. Net income, after interests charges, but before providing for depreciation was $2,723,044, an increase of $29,188. After dividends there remained a balance of $1,462,462, all of which was transferred to depreciation reserve, leaving the profit and loss surplus unchanged, except for the deduction of $40,114 for miscellaneous adjustments. The balance sheet, as of December 31 last, shows total assets and liabilities of $182,260,762. Current assets and treasury securities are listed at $14,747,171, of which $606,661 was cash, and current liabilities at $10,808,204. On the assets side appears an entry of $5,712,931 of deferred charges, made up of $4,300,549 discount on bonds, $1,371,347 discount on common stock, and $41,305 prepaid interest and taxes.

THE combined net earnings available for dividends of subsidiary companies of the Massachusetts Gas Companies for April, were $230,902, a decrease of $6,291, or 2.65 per cent., as compared with corresponding month a year ago. Increases in gas outputs for April and the 10 months compare as follows (in per cent.):

	April		10 Mos.	
	1914	1913	1914	1913
Boston	3.25	2.96	3.41	5.19
East Boston	9.54	12.33	9.55	13.25
Quincy	14.29	24.93	19.16	23.00
Newton	8.77	10.90	9.63	12.01

The net earnings of the subsidiary companies available for dividends for the 10 months ended April 30 compare as follows:

Gas Dept.	1913-14	1912-13
Boston	$1,077,252	$1,225,173
East Boston	55,379	72,306
Quincy	18,088	18,939
Newton	41,450	66,975
Coal Dept.		
New Eng. Coal	659,763	250,982
New Eng. Coke	176,229	638,542
Federal Coal	59,033	17,195
Boston Tow Boat	27,295	46,238
Totals	$2,114,494	$2,386,269

FOR the year ended March 31, operating subsidiaries of Standard Gas and Electric Company gained 8.1 per cent. in number of customers, 14.8 per cent. in lighting load, 15.6 per cent. in power load, and 14.9 per cent. in kilowatts connected for all purposes. On March 31, 1914, the company had 288,192 customers on the books of its operating companies, with a connected load of 301,876 kilowatts.

AT the special meeting of the American Gas and Electric Company, stockholders voted to increase the capital stock of the Company by authorizing $500,000 additional common stock, with par value of $50. All common stock authorized by the previous increase in capital has been allotted to stockholders and the new stock will remain as treasury stock until such times as the Board of Directors approve its distribution to common shareholders.

GROSS earnings of the People's Gas Light and Coke Company, of Chicago, thus far this year show a moderate increase. Operating expenses have been lowered, with the result that a greater percentage of income has been saved for net earnings. In recent years the Company's reports show about 38 or 39 per cent. of gross saved for net. Bond interest, depreciation and dividends come out of the net balance, and in the current year there should be a larger fund to draw upon. The improvement shown is thought due to the new policies put in effect since Samuel Insull took hold of the management of the gas company. There is a moderate but steady demand for the stock around current market prices, which suggests both investment and speculative accumulation.